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NATIONAL DAM SAFETY PROGRAM. BRONX RIVER DAM (INVENTORY NUMBER --ETC(U)
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization. Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal any conditions which constitute an immediate hazard to human life or property.		

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Using the Corps of Engineers' screening criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 10 percent of the Probable Maximum Flood (PMF). Therefore, the spillway is adjudged as "seriously inadequate," and the dam is assessed as "unsafe, non-emergency."

Structural stability analyses based on available information, indicate that the factors of safety against overturning are generally low, and the locations of the resultants fall outside of the middle 1/3. When the dam is subjected to severe loading conditions such as a PMF event, the factor of safety falls below the critical level.

Therefore, it is recommended that, within three months of owner notification, detailed hydrologic and hydraulic investigations of the structure should be undertaken to more accurately determine the site-specific characteristics of the watershed and their effects upon the overtopping potential of the dam. At the same time, further analyses of the structural stability of the dam should be performed. The results of these investigations and analyses will determine the appropriate remedial measures. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Around-the-clock surveillance must also be provided during these periods.

Current inspection and maintenance procedures by the owner are adequate but need to be documented. Monitoring of the reservoir levels should be expanded to include readings during peak flow periods.

The following remedial measures must be completed within one year:

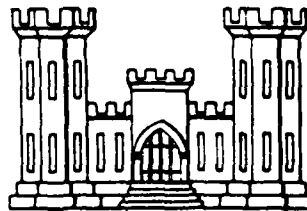
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2. Fill, compact, and seed the area of erosion behind the left training wall.
3. Repair the mortar joints on the crest of the dam.
4. Clear the debris from the spillway crest.

LOWER HUDSON RIVER BASIN

BRONX RIVER DAM

**BRONX COUNTY, NEW YORK
INVENTORY NO. N.Y. 1500**

**PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**



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NEW YORK DISTRICT CORPS OF ENGINEERS

AUGUST 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
BRONX RIVER DAM
I.D. No. NY 1500
DEC DAM No. 215C-4452, LOWER HUDSON RIVER BASIN
BRONX COUNTY, NEW YORK

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Bronx River Dam (I.D. No. NY 1500)
State: New York
County: Bronx
Stream: Bronx River
Date of Inspection: 7 March 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal any conditions which constitute an immediate hazard to human life or property.

Using the Corps of Engineers' screening criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 10 percent of the Probable Maximum Flood (PMF). Therefore, the spillway is adjudged as "seriously inadequate," and the dam is assessed as "unsafe, non-emergency."

Structural stability analyses based on available information, indicate that the factors of safety against overturning are generally low, and the locations of the resultants fall outside of the middle 1/3. When the dam is subjected to severe loading conditions such as a PMF event, the factor of safety falls below the critical level.

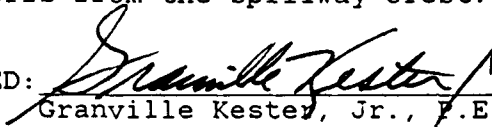
Therefore, it is recommended that, within three months of owner notification, detailed hydrologic and hydraulic investigations of the structure should be undertaken to more accurately determine the site-specific characteristics of the watershed and their effects upon the overtopping potential of the dam. At the same time, further analyses of the structural stability of the dam should be performed. The results of these investigations and analyses will determine the appropriate remedial measures. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Around-the-clock surveillance must also be provided during these periods.

Current inspection and maintenance procedures by the owner are adequate but need to be documented. Monitoring of the reservoir levels should be expanded to include readings during peak flow periods.

The following remedial measures must be completed within one year:

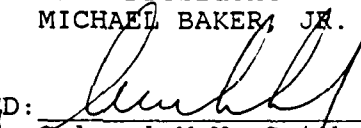
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2. Fill, compact, and seed the area of erosion behind the left training wall.
3. Repair the mortar joints on the crest of the dam.
4. Clear the debris from the spillway crest.

SUBMITTED:


Granville Kester, Jr., P.E.
Vice President

MICHAEL BAKER, JR. of New York, INC.

APPROVED:


Colonel W.M. Smith, Jr.
New York District Engineer

DATE:

14 Aug 81



Overall View of Dam
Bronx River Dam
I.D. No. NY 1500
7 March 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
BRONX RIVER DAM
I.D. No. NY 1500
DEC DAM No. 215C-4452
LOWER HUDSON RIVER BASIN
BRONX COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

- a. Authority - The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.
- b. Purpose of Inspection - This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam - Bronx River Dam is a stone and mortar structure 17.7 feet high¹ and 121.5 feet long. The right section of the dam² has a crest width of about 5.5 feet, an upstream slope of 1H:5.9V (Horizontal to Vertical), and a downstream slope of 1H:4.9V.

The spillway is a broad-crested, concrete weir with a breadth of 4 feet parallel to the flow. The spillway starts 32 feet from the right abutment and extends 89.5 feet to the stone wall on the left abutment. The upstream side of the spillway is an 8-inch high vertical face. The downstream side of the spillway is on 1H:5.3V slope down to a 1-foot long step that extends

¹Measured from the invert of the outlet pipe at the downstream toe to minimum crest of dam.

²Looking downstream.

across the width of the spillway about 3 feet below the spillway crest. From this step, water cascades over large rocks (about 1 to 3 feet square), mortared together to form a rough 1H:2V slope. Water drops from these stones and into the river at the toe of the dam. The spillway crest is about 3.4 feet lower than the elevation of the right side of the dam. The left side of the spillway is against a 2-foot wide vertical mortared stone wall that is about 3.5 feet higher than the spillway crest.

A 3-foot diameter iron pipe acts as the outlet for the dam. The valve that controls the flow through this pipe is located on a 7-foot wide masonry deck, 16 feet upstream from the right side of the dam. The outlet of this pipe is about 10 feet downstream from the crest of the spillway.

- b. Location - Bronx River Dam is located on the Bronx River at the south side of the Bronx City Zoo in New York City, New York. The dam is in Bronx County, New York. The coordinates for the dam are N 40° 50.6' and W 73° 52.6'. The dam can be found on the Central Park, New York USGS 7.5 minute topographic quadrangle. A location map is included in this report in Appendix E.
- c. Size Classification - Bronx River Dam is 17.7 feet high, and the reservoir storage capacity at the minimum top of dam (elevation 33.4 feet M.S.L. is 108 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams (Reference 13, Appendix D).
- d. Hazard Classification - The dam is in a highly urbanized area. There are many apartment houses and businesses located on the river banks downstream of the dam. A playground is located about 200 feet downstream of the dam. In the event of dam failure, loss of life and significant economic damage to downstream structures are considered likely. Therefore, Bronx River Dam is considered to be in the "high" hazard category, as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only, and is not related to its stability or probability of failure.

- e. Ownership - Bronx River Dam is owned by New York City, New York. The person in charge of the dam is David Cole, Deputy Director of Operations, New York Zoological Society, Southern Boulevard at 185th Street, Bronx, New York 10460 (telephone 212-220-5100).
- f. Purpose of Dam - Bronx River Dam is used for recreation.
- g. Design and Construction History - According to available information, the dam was probably built around 1900. No other information about the design or construction history was available.
- h. Normal Operating Procedures - The reservoir level is usually maintained near the crest of the spillway at elevation 30.0 feet M.S.L. According to the owner's representative, the valve controlling the outlet pipe is opened, and the reservoir is drained every two or three years.

1.3 PERTINENT DATA

- a. Drainage Area (Square Miles) - 36.36
- b. Discharge at Dam (c.f.s.) -

Spillway Capacity (at Minimum Top of Dam Elev. 33.4 ft. M.S.L.)	1571.0
Reservoir Drain at Normal Pool	123.0
- c. Elevations (Feet Above M.S.L.)¹ -

Minimum Top of Dam	33.4
Normal Pool (Spillway Crest)	30.0
Outlet Pipe at Toe of Dam	15.7
- d. Reservoir Surface (Acres) -

Top of Dam (Elev. 33.4 ft. M.S.L.)	17.70
Spillway Crest (Elev. 30.0 ft. M.S.L.)	12.48
- e. Reservoir Storage Capacity (Acre-Feet) -

Top of Dam (Elev. 33.4 ft. M.S.L.)	108.0
Spillway Crest (Elev. 30.0 ft. M.S.L.)	58.0

¹All elevations are referenced to the spillway crest, elev. 30.0 ft. M.S.L., estimated from the USGS 7.5 minute topographic quadrangle, Central Park, New York.

f. Dam -

Type: Stone and mortar.

Length (Feet) 121.5

Height (Feet) 17.7

Top Width (Feet) 5.5

Side Slopes - Upstream 1H:5.9V

Downstream 1H:4.9V

Cut-off - No information available.

g. Spillway -

Type: Concrete broad-crested weir

Crest Length Perpendicular to Flow (Feet) 89.5

Crest Width Parallel to Flow (Feet) 4.0

Crest Elevation (ft. M.S.L.) 30.0

h. Reservoir Drain -

Type: One 3-foot diameter iron pipe that extends through the base of the dam on the right side.

Control: Manual control valve operated from the stone and masonry deck that extends upstream from the right side of the dam.

SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

The Bronx River Dam is located in the "New England Upland Lands" physiographic province of New York State. This province is geologically complex and characteristically composed of igneous and metamorphic rocks which have been tectonically disturbed by a number of thrust and normal faults.

Bedrock in the immediate vicinity of the dam is represented by Ordovician and Precambrian rocks. The Ordovician rocks are composed of hornblende; the Manhattan Formation, undifferentiated schist to gneiss; and the Inwood Marble. The Precambrian rocks consist of the Fordham Gneiss, undifferentiated, and the Yonkers Gneiss. The State of New York has mapped a fault within 2 miles of the dam site, the contact of which is uncertain. That section of the fault in the vicinity of the dam may be a possible root zone of the taconic nappes and other possible taconic thrusts.

2.2 SUBSURFACE INVESTIGATION

Subsurface information was unavailable for reference as a part of this investigation. Soil on the left abutment consists of stony loam with angular-to-rounded rock fragments and gravel and a fractional amount of cobble size rocks. The right abutment of the dam consists of chlorite mica schist with nearly vertical fractures orientated upstream to downstream. Boulders used for the dam (at the left end where debris diverts the water from cascading over the spillway) consist of quartz mica schist material and average approximately 3 feet in size.

2.3 DAM AND APPURTENANT STRUCTURES

The dam is a stone masonry structure with an upstream slope of 1H:5.9V (Horizontal to Vertical), a crest width of 5.5 feet, and a downstream slope of 1H:4.9V. The spillway is an 89.5-foot broad-crested weir beginning 32 feet from the right abutment. The spillway discharges into the natural stream channel.

The control valve for the 3-foot diameter iron outlet pipe is located on a 7-foot wide stone masonry deck, 16 feet upstream from the crest of the dam.

2.4 CONSTRUCTION RECORDS

Construction records were unavailable for this investigation.

2.5 OPERATING RECORDS

No formal operation records are maintained by the City of New York. The control gate is opened, and the reservoir is drained every two or three years. Maintenance is performed as needed.

2.6 EVALUATION OF DATA

The background information collected during this investigation was obtained verbally from Mr. David Cole, Deputy Director of Operations, New York Zoological Society. Available engineering data are considered adequate and reliable for Phase I Inspection purposes.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

- a. General - The visual inspection of Bronx River Dam was conducted on 7 March 1981. The weather was cloudy and the temperature was around 35° to 40° F. The ground surface was generally frozen and covered with a light dusting of snow. At the time of inspection, the reservoir level was at 30.3 feet M.S.L. Deficiencies found during the inspection will require remedial treatment. A Field Sketch of conditions found during the inspection is included in Appendix E. The complete Visual Inspection Checklist is presented as Appendix B.
- b. Spillway - The spillway is a 4-foot wide concrete, broad-crested weir extending 89.5 feet across the length of the dam. A 3-inch water flow over the spillway crest at the time of inspection made visual observation difficult. There were no signs of cracking or crest settlement at the time of inspection. There was, however, some debris on the spillway crest partially obstructing the flow. Near the left abutment, debris almost stopped the water flow over the spillway. At this spot, the downstream face of the spillway appeared to be intact, and the mortar joints between these stones showed no signs of deterioration or spalling. Water discharges over the downstream face of the spillway into the natural river channel at the toe of the dam. The channel is lined with riprap. The left side of the spillway is bound by a 2-foot thick mortared stone wall on the left abutment. This wall was partially undercut at the wall base about 15 feet downstream of the spillway. The area behind this wall was eroded to a depth of almost 3 feet. There were no problems observed at the junction of the spillway and the right side of the dam. There was a 1-foot high and 18-inch wide concrete curb and spider fence on the left side of the spillway crest.
- c. Dam - Bronx River Dam is a masonry structure. Both the upstream and downstream faces are made of stone and mortar walls, and the top is capped by a rough mortared surface. There was some cracking observed on this top surface. There is a 1-foot high and 18-inch wide concrete curb and spider fence on the right side of the dam. There were a

few areas where weeds have grown between the joints of the stones on the upstream side near the water surface and on the downstream slope near the spillway. There was also an area of seepage observed about 3 feet above the toe of the wall on the right downstream side of the dam near the spillway. The rate of flow from this seep was estimated to be less than 0.5 g.p.m. and was flowing clear, although there was some iron staining at the area of this seep. There were no problems observed at the junction of the dam and the right abutment.

- d. Outlet Works - A 3-foot diameter iron pipe extends through the right side of the dam. This pipe is controlled by a gate valve operated from the masonry deck extending upstream from the right side of the dam. According to the owner's representative, this valve is operable and can be used to dewater the reservoir.
- e. Downstream Channel - The downstream channel below the spillway is a 70-foot to 100-foot wide river channel bound by vertical mortared stone walls on each side. There is a playground on the right abutment about 200 feet downstream of the dam. A stone bridge crosses the channel about 400 feet below the dam. There are many buildings built right on the river walls on both banks.
- f. Reservoir - The reservoir slopes are mostly flat with some bare rock outcroppings. There were no signs of instability, and sedimentation was not reported to be a problem.

3.2 EVALUATION

The visual inspection revealed several deficiencies in this structure. The following were noted:

- 1. A clear seep (less than 0.5 g.p.m.) was observed exiting the dam 3 feet above the toe and 10 feet right from the outlet channel.
- 2. The left training wall is under cut about 15 feet downstream from the spillway.
- 3. An area of erosion was observed behind the left training wall.

4. Weeds are growing in the mortar joints along the crest of the dam.
5. Debris was located on the upstream crest of the spillway.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no formal written instructions for operating the reservoir. The normal water surface elevation is near the spillway crest elevation of 30.0 feet M.S.L. Water can be released to the downstream area through a 3-foot diameter iron pipe. This valve is operated from the masonry peninsula extending upstream from the toe of the dam.

4.2 MAINTENANCE OF DAM

Dam maintenance is the responsibility of the City of New York. There is no formal maintenance schedule for the dam.

4.3 WARNING SYSTEM

At the time of the inspection, there was no warning system or emergency action plan in operation.

4.4 EVALUATION

Past maintenance of the dam and operating facilities appear to have been adequate, but the past activities have gone undocumented. A checklist should be compiled by the owner's representative to document the findings made during the periodic inspections and the maintenance items completed. A warning system and emergency action plan should be developed and put into operation.

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SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

The drainage area is mainly urbanized with some rural areas in the uppermost portion of the watershed. Some upland storage exists in the form of flat areas and small lakes. The total drainage area is 36.36 square miles.

5.2 ANALYSIS CRITERIA

The drainage area considered in this analysis does not include the drainage areas for Kensico Reservoir; White Plains Reservoirs 1 and 2; and the Grassy Sprain Reservoir, located in the upper reaches of the Bronx River, because their entire inflows are diverted for municipal water supply.

The hydraulic capacity of the dam, reservoir, and spillway was assessed by utilizing the U.S. Army Corps of Engineers Flood Hydrograph Package HEC-1 DB. The hydrologic characteristics of the basin (specifically the Snyder's unit hydrograph parameters) were average values derived from the Hydrologic Flood Routing Model for Lower Hudson River Basin, Bronx River (Reference 14, Appendix D). The runoff hydrograph was developed by simulating the Standard Project Storm (SPS). Total SPS rainfall and excess were used to approximate the SPS flow at West Farms, approximately 2500 feet below Bronx River Dam, of 12,845 c.f.s. Using $t_p = 10.0$ hr.; $C_p = 0.57$, initial rainfall loss of 2.0 inch; and a constant loss rate of 0.3 inches per hour, a flow of 13,060 c.f.s. was obtained. This flow is within 2 percent of the SPS flow value calculated for this point in the Hydrologic Flood Routing Model for Lower Hudson River Basin, Bronx River. The PMP rainfall amounts were then substituted for the SPS amounts. The PMF and 1/2 PMF were then routed through the reservoir and dam.

5.3 SPILLWAY CAPACITY

The spillway capacity at the minimum top of dam is 1571 c.f.s. There is no auxiliary or emergency spillway.

5.4 RESERVOIR CAPACITY

The storage capacity of Bronx River Dam at normal pool is 58 acre-feet. The storage capacity of the reservoir at the minimum top of dam is 108 acre-feet. Therefore, the flood control storage of the reservoir between the spillway crest and the top of dam is 50 acre-feet. This

volume represents a total runoff of 0.03 inches from the drainage area.

5.5 FLOODS OF RECORD

The maximum flow at West Farms, approximately 2500 feet downstream from Bronx River Dam, was 3698 c.f.s. during Agnes in 1972. This should have overtopped the dam by approximately 1 foot. The owner, however, was unable to confirm this.

5.6 OVERTOPPING POTENTIAL

The maximum capacity of the spillway is 1571 c.f.s. before overtopping would occur. The peak outflows of the PMF and 1/2 PMF are 20,405 c.f.s. and 10,207 c.f.s., respectively. Therefore, the spillway is capable of passing 10 percent of the PMF before overtopping would occur.

5.7 RESERVOIR EMPTYING POTENTIAL

The reservoir can be drawn down by means of a 3-foot diameter outlet pipe. Neglecting inflow, the reservoir can be drawn down from normal pool in approximately 6.5 hours. This is equivalent to an approximate drawdown rate of 1.5 feet per hour, based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.

5.8 EVALUATION

Bronx River Dam is a "small" size - "high" hazard dam requiring the spillway to pass a flood in the range of the 1/2 PMF to PMF. The PMF and 1/2 PMF were routed through the watershed and dam. It was determined that the spillway is capable of passing 10 percent of the PMF before overtopping the dam. Structural stability analyses based on available information, indicate that factors of safety against overturning are less than desirable. When the dam is subjected to severe loading conditions such as the 1/2 PMF or PMF events, the factors of safety fall to critical levels. Therefore, the spillway is judged to be "seriously inadequate."

Conclusions pertain to present conditions, and the effect of future development on the hydrology has not been considered.

SECTION 6: STRUCTURE STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations - No signs of instability were noted during the field inspection. Minor problems observed which could affect the stability of the structure include:
 1. A clear seep (less than 0.5 g.p.m.) was observed exiting the dam 3 feet above the toe and 10 feet right from the outlet channel.
 2. The left training wall is undermined approximately 15 feet downstream from the spillway.
 3. An erosion channel has formed behind the left training wall. This channel is as deep as 3 feet at places.
- b. Design and Construction Data - Design and construction data were unavailable.
- c. Operating Records - The owner's representative reported that the reservoir was drawn down several times. No additional operational information is available.
- d. Post Construction Changes - Information concerning post construction changes is unavailable.

6.2 STABILITY ANALYSIS

The results of any previous stability analyses were unavailable for reference during this evaluation. A structural stability analysis was conducted for a typical spillway section. The cases analyzed and respective results are as follows:

<u>Case</u>	<u>Description of Loading Conditions</u>
1	Normal operating conditions with reservoir level at the spillway crest, full uplift, and 2.2 feet of tailwater.
2	Same as Case 1 with the additional ice loading of 5000 pounds per lineal foot.
3	Reservoir level during 1/2-PMF, full uplift, with a tailwater of 7.5 feet.
4	Reservoir level during the PMF, full uplift, with a tailwater of 10.0 feet.

Case	Factor of Safety		Location of Resultant From Toe (ft.)
	Overturning	Sliding	
1	2.06	7.10	7.78
2	1.26	3.86	3.08
3	1.09	3.44	1.96
4	0.99	3.23	-0.41

Notes: Location of middle 1/3 is 10.67 to 5.33 feet from the downstream toe.

A negative sign (-) above indicates that the location of the resultant is downstream from the toe.

A value of 2 ksf was used as a conservative approximation of the shear strength of weathered rock.

In all cases, the factors of safety against sliding exceed the recommended value of 3. The factors of safety against overturning are low, and the resultants fall outside of the middle 1/3 (except for Case 1 - Normal Pool). Therefore, the dam is considered unsafe against overturning. However, the structure withstood normal loading conditions in the past without apparent damage, and the analyses may not indicate the true field conditions or proper loading conditions. Since overturning during the SDF would result in a probable loss of life downstream of the dam, a detailed stability analysis of the dam should be performed by a qualified engineering firm within three months of owner notification.

6.3 SEISMIC STABILITY

Bronx River Dam is located in Seismic Zone 1 which presents no hazard from earthquakes, according to the Recommended Guidelines for Safety Inspection of Dams by the Department of the Army, Office of the Chief of Engineers. This determination is contingent on the requirements that static stability conditions are satisfactory, and conventional safety margins exist. As indicated in Paragraph 6.2, the dam has low factors of safety against overturning. If the requested additional analysis does not indicate conventional safety margins against overturning, additional analysis of the effects of earthquakes on the structural stability should be performed.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

- a. Safety - Examination of available documents and visual inspections of Bronx River Dam did not reveal any conditions which constitute an immediate hazard to human life or property.

Using the Corps of Engineers' screening criteria for review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 10 percent of the PMF. The overtopping of the dam could result in dam failure, increasing the hazard to loss of life downstream. Therefore, the spillway is adjudged as "seriously inadequate," and the dam is assessed as "unsafe, non-emergency."

The stability analyses of the dam performed for this investigation indicate that the factors of safety against overturning may be inadequate.

- b. Adequacy of Information - The information available and the observations and measurements made during the visual inspection are considered sufficient for this Phase I Inspection Report.
- c. Need for Additional Investigation - Detailed hydrologic and hydraulic investigations of the watershed and reservoir area are considered necessary to more accurately determine the overtopping potential of the dam. After the in-depth hydrologic/ hydraulic investigations have been completed, remedial measures must be initiated to provide spillway capacity sufficient to discharge the outflow from the 1/2 PMF event. A detailed stability analysis of the dam is considered necessary to determine actual stability conditions.
- d. Urgency - The detailed hydrologic and hydraulic and stability investigations must be initiated within three months of notification to the owner. Within one year, remedial measures resulting from these investigations must be initiated and completed during the following year. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Around-the-clock surveillance must also be provided during these periods.

7.2 RECOMMENDED MEASURES

The regular inspections and maintenance procedures presently conducted by the owner's representative appear to be adequate, although some form of documentation is needed. A thorough checklist should be compiled by the owner's representative and completed during each inspection. Maintenance items should be completed annually. Monitoring of the reservoir level should be expanded to include reservoir levels above normal pool.

A formal warning system and emergency action plan should be developed and put into action as soon as possible.

The following remedial measures must be completed within one year:

1. Fill beneath the left training wall and protect with riprap.
2. Fill, compact, and seed the area of erosion behind the left training wall.
3. Repair the mortar joints on the crest of the dam.
4. Clear the debris from the spillway crest.

APPENDIX A
PHOTOGRAPHS

CONTENTS

- Photo 1: View of Upstream Side of Dam. Outlet Gate Valve Stem Located in Foreground.
- Photo 2: View of Downstream Face of Dam. Outlet Pipe Located at Bottom Left of Photo in Spillway Discharge Area
- Photo 3: View Across Crest of Spillway From Right Training Wall
- Photo 4: View Across Crest of Spillway From Left Abutment
- Photo 5: View of Outlet Valve Stem
- Photo 6: View Looking Downward at Outlet Pipe
- Photo 7: View of Left Training Wall of Spillway
- Photo 8: View of Erosion Behind Left Training Wall of Spillway
- Photo 9: View Across Downstream Face of Spillway Right Abutment. Note Staining in Bottom Center of Photo on Downstream Face of Dam.
- Photo 10: View of Minor Seepage Through Dam.
(See Photo 9 for Location)

Note: Photos were taken 7 March 1981.

BRONX RIVER DAM



Photo 1. View of Upstream Side of Dam
Outlet Gate Valve Stem Located in Foreground
7 March 1981



Photo 2. View of Downstream Face of Dam
Outlet Pipe Located at Bottom Left of Photo in Spillway Discharge Area
7 March 1981

BRONX RIVER DAM

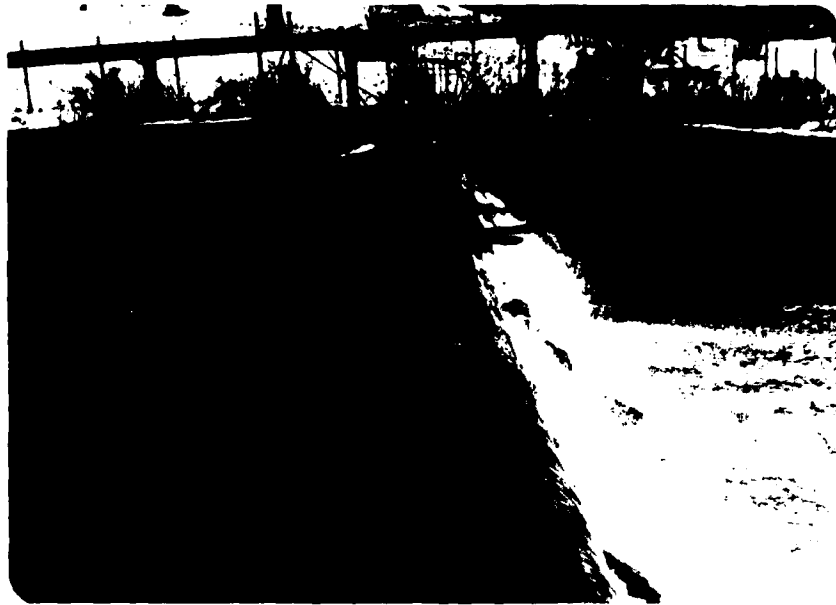


Photo 3. View Across Crest of Spillway from Right Training Wall
7 March 1981



Photo 4. View Across Crest of Spillway From Left Abutment
7 March 1981

BRONX RIVER DAM



Photo 5. View of Outlet Valve Stem
7 March 1981

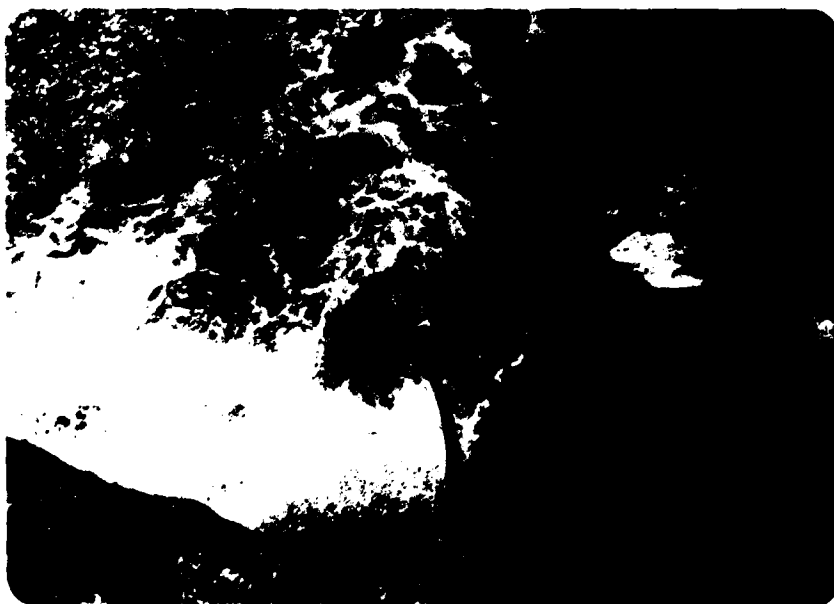


Photo 6. View Looking Downward at Outlet Pipe
7 March 1981

BRONX RIVER DAM



Photo 7. View of Left Training Wall of Spillway
7 March 1981



Photo 8. View of Erosion Behind Left Training Wall of Spillway
7 March 1981

BRONX RIVER DAM



Photo 9. View Across Downstream Face of Spillway Right Abutment
Note Staining in Bottom Center of Photo on Downstream Face of Dam
7 March 1981



Photo 10. View of Minor Seepage Through Dam
(See Photo 9 for Location)
7 March 1981

APPENDIX B
VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Bronx River Dam

Fed. I.D. # NY 1500 DEC Dam No. 215C-4452

River Basin Lower Hudson

Location: Town Bronx County Bronx

Stream Name Bronx River

Tributary of East River

Latitude (N) 40° 50.60' Longitude (W) 73° 52.59'

Type of Dam Masonry and concrete

Hazard Category High

Date(s) of Inspection 7 March 1981

Weather Conditions Cloudy, 35° - 40°

Reservoir Level at Time of Inspection 30.3 ft. M.S.L.

b. Inspection Personnel James Ulinski, Anthony Klimek, Steve Lockington

c. Persons Contacted (Including Address & Phone No.) 212-220-5100

David Cole, Deputy Director of Operations

New York Zoological Society

Southern Blvd. at 185th Street

Bronx, NY 10460

d. History:

Date Constructed About 1900 Date(s) Reconstructed _____

Designer Unknown

Constructed By Unknown

Owner City of New York, New York

2) Embankment N/A

a. Characteristics

- (1) Embankment Material _____

- (2) Cutoff Type _____

- (3) Impervious Core _____

- (4) Internal Drainage System _____

- (5) Miscellaneous _____

b. Crest

- (1) Vertical Alignment _____

- (2) Horizontal Alignment _____

- (3) Surface Cracks _____

- (4) Miscellaneous _____

c. Upstream Slope

- (1) Slope (Estimate) (V:H) _____

- (2) Undesirable Growth or Debris, Animal Burrows _____

(3) Sloughing, Subsidence, or Depressions _____

(4) Slope Protection _____

(5) Surface Cracks or Movement at Toe _____

d. Downstream Slope

(1) Slope (Estimate - V:H) _____

(2) Undesirable Growth or Debris, Animal Burrows _____

(3) Sloughing, Subsidence or Depressions _____

(4) Surface Cracks or Movement at Toe _____

(5) Seepage _____

(6) External Drainage System (Ditches, Trenches, Blanket) _____

(7) Condition Around Outlet Structure _____

(8) Seepage Beyond Toe _____

e. Abutments - Embankment Contact _____

(1) Erosion at Contact _____

(2) Seepage Along Contact _____

3) Drainage System

a. Description of System None _____

b. Condition of System Not applicable _____

c. Discharge from Drainage System Not applicable _____

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs,
Piezometers, Etc.) None _____

5) Reservoir

a. Slopes Slopes are steep to mild.

b. Sedimentation Sedimentation was not reported to be a problem.

c. Unusual Conditions Which Affect Dam None observed

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) Downstream area is very developed, consisting of apartments and businesses. A playground is located 200 ft. downstream.

b. Seepage, Unusual Growth Seepage 10 ft. from the outlet conduit was observed to be clear with less than 0.5 gpm rate of flow.

c. Evidence of Movement Beyond Toe of Dam No movement evidenced.

d. Condition of Downstream Channel Bridge located downstream. The channel has a masonry/riprap bottom and mortared masonry sides.

7) Spillway(s) (Including Discharge Conveyance Channel)

a. General The spillway is located 34 ft. from the right abutment, and consists of a concrete broad-crested weir 89.5 ft. wide (perpendicular to flow), and 4 ft. long (parallel to flow).

b. Condition of Service Spillway The spillway appears to be in fair condition. In some places, debris has piled up behind the spillway.

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel The discharge conveyance channel has minor growth and appeared to be in fair condition.

8) Reservoir Drain/Outlet

Type: Pipe X Conduit _____ Other _____

Material: Concrete _____ Metal _____ Other Iron

Size: 36 inch Length 30 ft. (estimated)

Invert Elevations: Entrance Unknown

Exit 15.68 ft.

Physical Condition (Describe): Unobservable X

Material: Iron

Joints: _____ Alignment _____

Structural Integrity: _____

Hydraulic Capability: _____

Means of Control: Gate _____ Valve X Uncontrolled _____

Operation: Operable X Inoperable _____ Other _____

Present Condition (Describe): At the time of inspection, the valve
was open and the reservoir was being lowered.

9) Structural

a. Concrete Surfaces Dam is mortared rockfill and in fair condition. Left
side of dam is a mortared stone wall about 2 ft. wide and 3.5 ft. high.

b. Structural Cracking No problems observed.

c. Movement - Horizontal & Vertical Alignment (Settlement) No movement
was observed.

d. Junctions with Abutments or Embankments Right abutment consists of
chlorite mica schist with vertical fractures. Erosion has occurred
behind the stone wall on the left abutment.

- e. Drains - Foundation, Joint, Face None observed.
- f. Water Passages, Conduits, Sluices Outlet conduit appeared to be in fair condition and was operating at the time of inspection.
- g. Seepage or Leakage Clear seepage (less than 0.5 gpm) was observed 10 ft. from the outlet conduit, about 3 ft. above the toe on the downstream side of the dam and ndear the spillway.
- h. Joints - Construction, etc. No problem observed.
- i. Foundation Unobservable
- j. Abutments Erosion has occurred behind the stone wall of the left abutment.
- k. Control Gates Unobservable

l. Approach & Outlet Channels Due to recent precipitation, the upstream channel was unobservable. The outlet channel was in fair condition.

m. Energy Dissipators (Plunge Pool, etc.) None

n. Intake Structures Unobservable

o. Stability No problems observed.

p. Miscellaneous _____

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition None

APPENDIX C
HYDROLOGIC/HYDRAULIC DATA AND COMPUTATIONS

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THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject BRONX RIVER DAM S.O. No. _____
APPENDIX C Sheet No. _____ of _____
HYDROLOGIC / HYDRAULIC CALC. Drawing No. _____
Computed by _____ Checked by _____ Date _____

<u>SUBJECT</u>	<u>PAGE</u>
CHECK LIST FOR DAMS	1
TOP OF DAM PROFILE	5
TYPICAL CROSS SECTION	6
SPILLWAY CROSS SECTION	7
SPILLWAY RATING	8
OUTLET PIPE RATING	9
OUTLET PIPE RATING SUMMARY	13
PMF DISCHARGE	14
SPILLWAY CAPACITY ANALYSIS	15
HEC-1 COMPUTER ANALYSIS	16

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	<u>Elevation</u> (ft.)	<u>Surface Area</u> (acres)	<u>Storage Capacity</u> (acre-ft.)
1) Top of Dam	<u>33.4</u>	<u>17.70</u>	<u>108</u>
2) Design High Water (Max. Design Pool)	<u>----</u>	<u>-----</u>	<u>--</u>
3) Auxiliary Spillway Crest	<u>----</u>	<u>-----</u>	<u>--</u>
4) Pool Level with Flashboards	<u>----</u>	<u>-----</u>	<u>---</u>
5) Service Spillway Crest	<u>30.0</u>	<u>12.48</u>	<u>58</u>

DISCHARGES

	<u>Volume</u> (cfs)
1) Average Daily	<u>38</u>
2) Spillway @ Maximum High Water - Top of Dam -	<u>1570</u>
3) Spillway @ Design High Water	<u>--</u>
4) Spillway @ Auxiliary Spillway Crest Elevation	<u>--</u>
5) Low Level Outlet	<u>123</u>
6) Total (of all facilities) @ Maximum High Water	<u>1693</u>
7) Maximum Known Flood	<u>Unknown</u>
8) At Time of Inspection	<u>36</u>

CREST:

ELEVATION: 33.4 ft.

Type: Masonry

Width: 5.5 ft.

Length: 121.5 ft.

Spillover Broad crested weir

Location 34 ft. from right abutment

SPILLWAY:

SERVICE

AUXILIARY

30.0 ft.

Elevation None

Broad crested weir

Type ----

89.5 ft.

Width ----

Type of Control

X

Uncontrolled ----

Controlled:

Type ----

(Flashboards; gate)

Number ----

Size/Length ----

Invert Material ----

Anticipated Length
of Operating Service ----

Chute Length ----

Height Between Spillway Crest
& Approach Channel Invert
(Weir Flow) ----

HYDROMETEROLOGICAL GAGES:

Type: None

Location: _____

Records: _____

Date: _____

Max. Reading: _____

FLOOD WATER CONTROL SYSTEM:

Warning System: None

Method of Controlled Releases (mechanisms):

Outlet conduit with a gate valve

DRAINAGE AREA: 36.36 sq. mi.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Urban

Terrain - Relief: Steep to mild

Surface - Soil: Well drained

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

No plans for changes in the basin

Potential Sedimentation problem areas (natural or man-made; present or future)

No problems reported

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

No problems observed

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 3000 ft.

Length of Shoreline (@ Spillway Crest) 6200 ft.

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Subject BRONX RIVER DAM

TOP OF DAM PROFILE

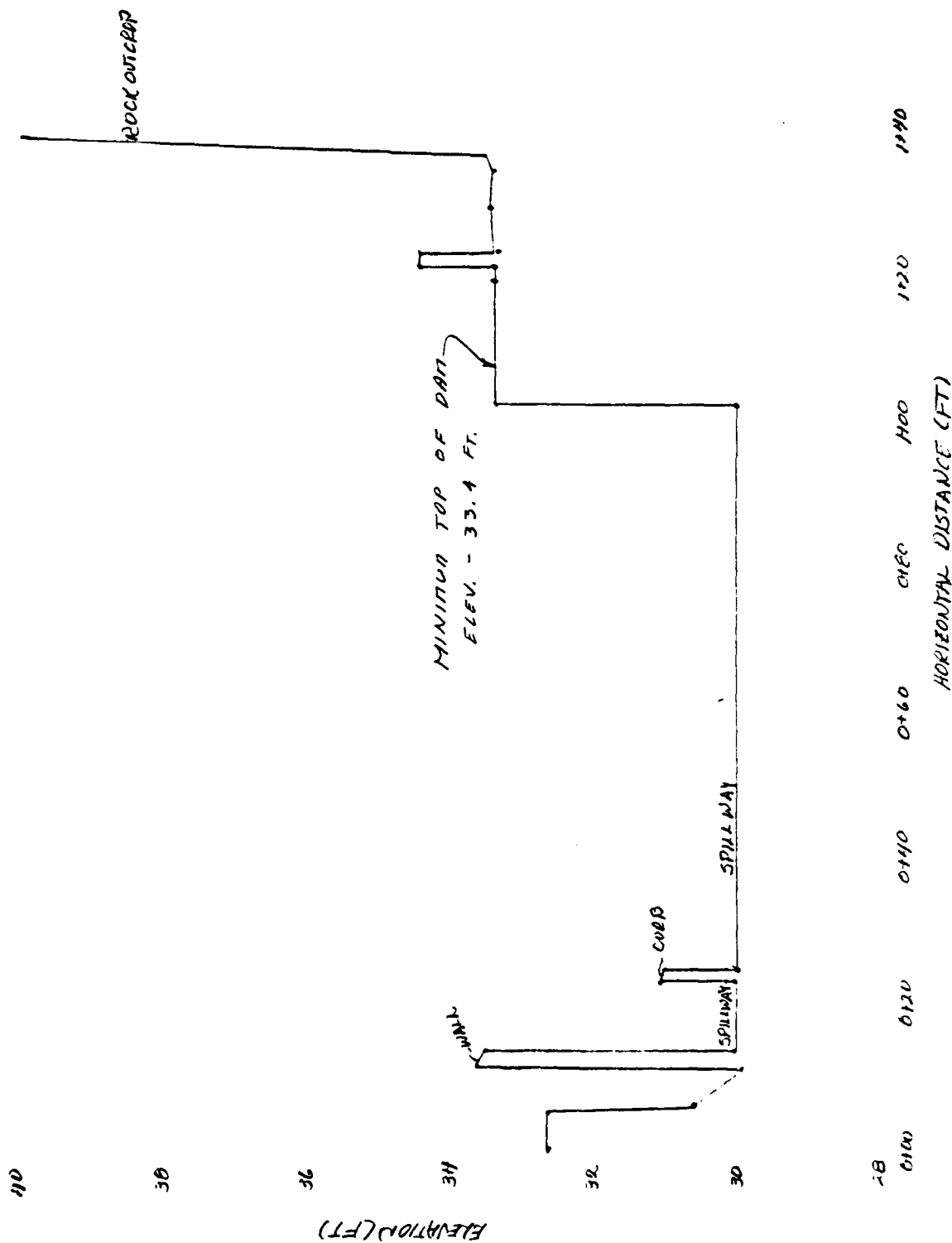
S.O. No. _____

Sheet No. 5 of 25

Drawing No. _____

Computed by S.M.L. Checked by JE

Date 3/12/51

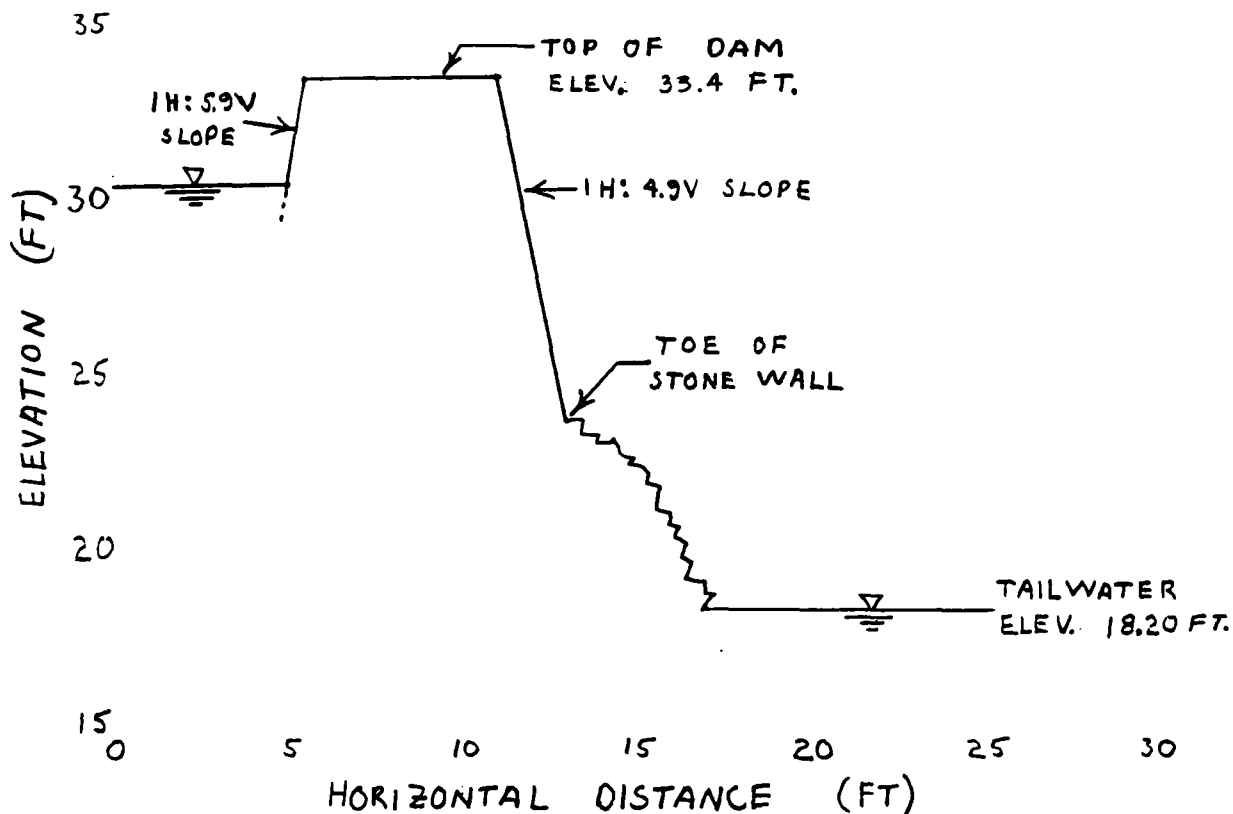


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Subject BRONX RIVER DAM S.O. No. _____
CROSS SECTION AT STA 1+15 Sheet No. 6 of 25
Drawing No. _____
Computed by APK Checked by JE Date 3-22-81

CROSS SECTION OF DAM AT STATION 1+15

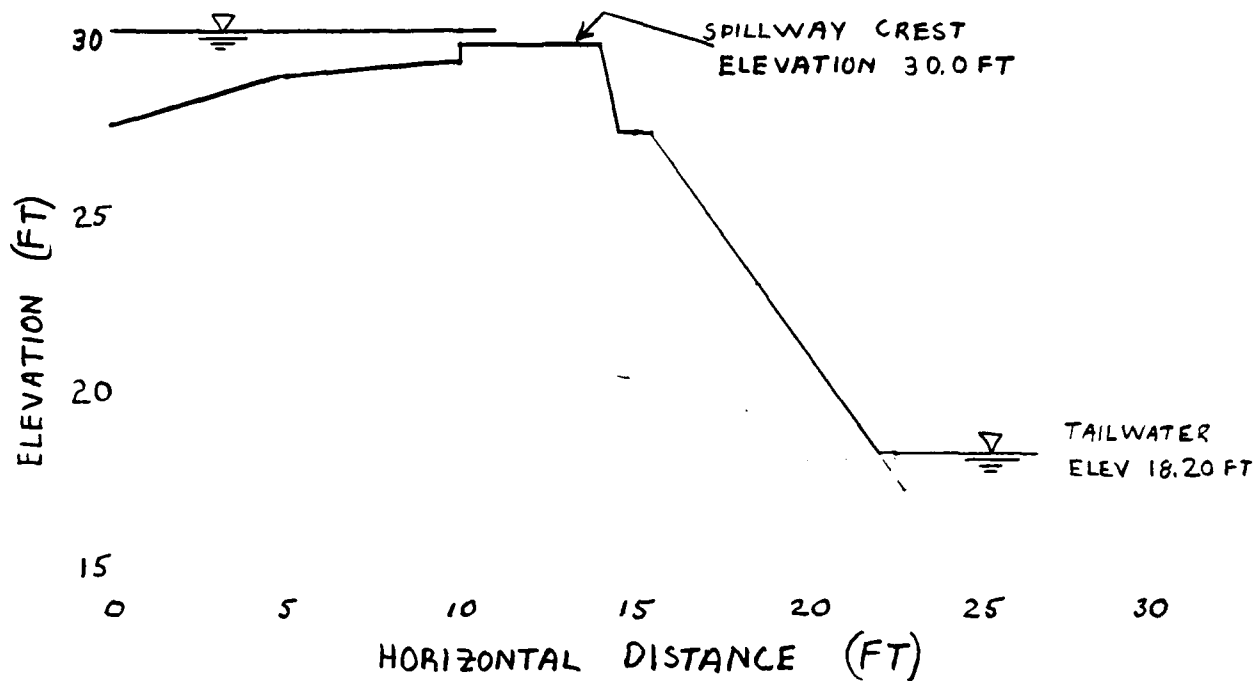


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Subject BRONX RIVER DAM S.O. No. _____
SPILLWAY CROSS SECTION Sheet No. 7 of 25
Drawing No. _____
Computed by APK Checked by JE Date 3-22-81

SPILLWAY CROSS SECTION



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Subject BRINX RIVER DAM S.O. No. _____
SPILLWAY RATING Sheet No. 8 of 25
Drawing No. _____
Computed by APK Checked by [Signature] Date 3-22-81

Weir Flow

$$Q = CLH^{3/2}$$

$$Q = C 89.5 H^{3/2}$$

$$L = 89.5 \text{ FT}$$

H varies from 0 to 12 feet and is measured from the crest of the spillway (elevation 30.0 ft M.S.L.)

ELEVATION	C	H (FT)	Q (cfs)
30.0	—	0	0
30.3	2.5	0.3	368
31.0	2.7	1.0	242
32.0	2.7	2.0	683
33.0	2.7	3.0	1256
33.4	2.8	3.4	1571
34.0	2.8	4.0	2005
36.0	3.3	6.0	4341
38.0	3.3	8.0	6683
40.0	3.3	10.0	9340
42.0	3.3	12.0	12277
44.0	3.3	14.0	15471
46.0	3.3	16.0	18902

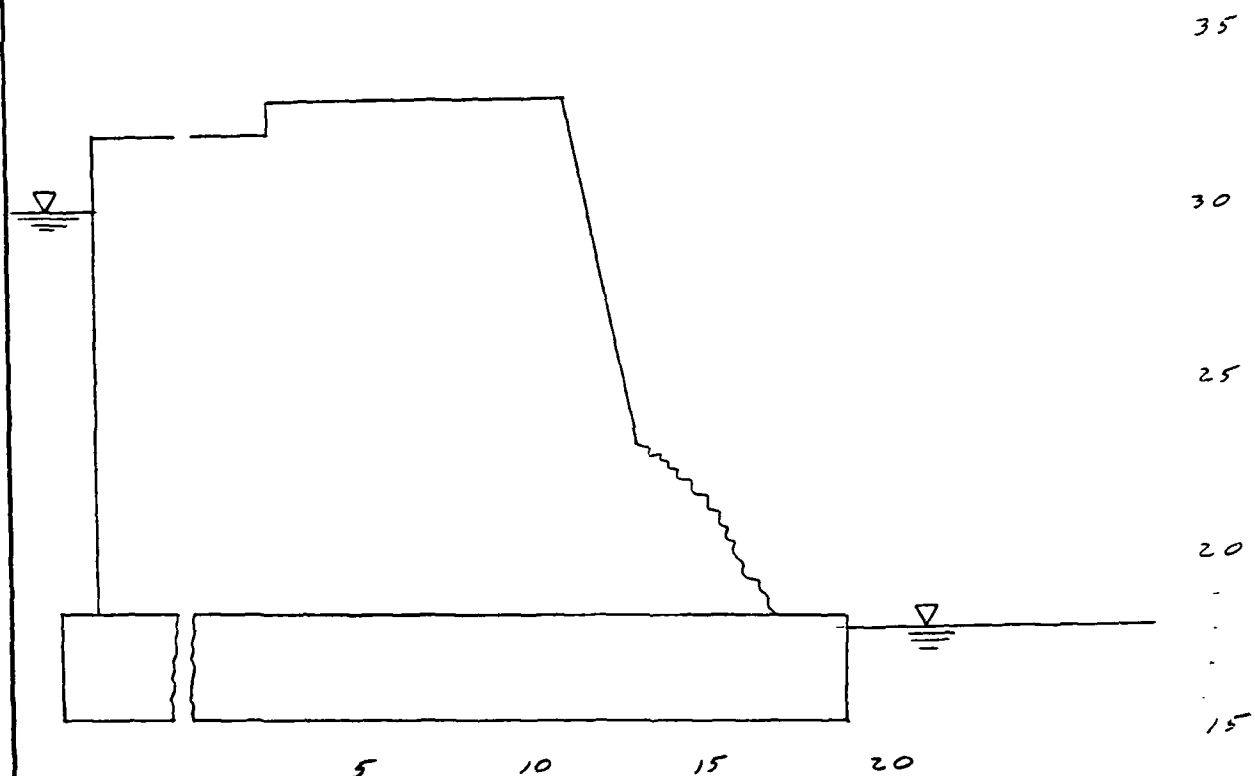
C varies with H, King and Brater Handbook pg 5-40 Table 5-3

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Subject BRONX RIVER DAM S.O. No. _____
OUTLET PIPE RATING Sheet No. 9 of 25
Drawing No. _____
Computed by GWT Checked by LAD Date 4/29/81

TYPICAL SECTION THRU OUTLET PIPE



5 10 15 20
INLET ELEV. - 16.0 FT. (ASSUMED) /
OUTLET ELEV. - 15.5 FT. /
PIPE DIAMETER - 3 FEET /
PIPE LENGTH - 30 FEET /
TAIL WATER - 18.2 FEET /

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Subject BRUNX RIVER DAM
OUTLET PIPE RATING

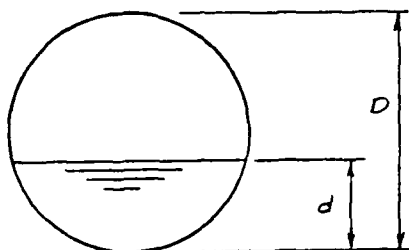
S.O. No. _____

Sheet No. 10 of 25

Drawing No. _____

Computed by GUT Checked by LAD Date 4/30/81

"DESIGN OF SMALL DAMS" PAGES 558 AND 559



$D = \text{DIA. PIPE}$ ✓
 $d = \text{DEPTH OF WATER}$ ✓
 $S = \text{PIPE SLOPE}$
 $= \frac{16. - 15.5}{30} = 0.017$ ✓

$n = 0.014$ ✓

ELEVATION = 18.0

$\frac{d}{D} = \frac{1}{2} = .5$ TABLE B-2 $1.3955 = \frac{Q_c}{D^{5/2}} = \frac{Q}{3^{5/2}}$ $Q = 21.75 \text{ CFS}$ ✓

$\frac{d}{D} = \frac{1}{2} = .5$ TABLE B-3 $.232 = \frac{Q n}{D^{5/2} S^{1/2}} = \frac{Q (.014)}{3^{5/2} (.017)^{1/2}}$ $Q = 40.45 \text{ CFS}$ ✓

ELEVATION = 18.75

$\frac{d}{D} = \frac{2.25}{3} = .75$ TABLE B-2 $3.0607 = \frac{Q_c}{D^{5/2}} = \frac{Q}{3^{5/2}}$ $Q = 47.71$ ✓

$\frac{d}{D} = \frac{2.25}{3} = .75$ TABLE B-3 $.422 = \frac{Q n}{D^{5/2} S^{1/2}} = \frac{Q (.014)}{3^{5/2} (.017)^{1/2}}$ $Q = 73.57$ ✓

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Beaver, Pa. 15009

Subject BEUNK RIVER DAM
OUTLET PIPE RATING

Computed by GWT

Checked by LAD

S.O. No.

Sheet No. 11 of 25

Drawing No.

Date 4/30/81

ORIFICE FLOW

$$Q = CA (2gH)^{.5}$$

$$Q = 34.04 (H)^{.5}$$

$$A = \pi R^2 = \pi (1.5)^2 = 7.07 \text{ FT}^2$$

$$g = 32.2 \text{ FT/SEC}^2$$

H VARIES FROM 2 FT TO 12 FT

C = 0.6 FROM TABLE 4-6 PG. 4-32

KING + DEATER 1-3 FT L = 30 FT.

HEAD MEASURED TO CENTER OF PIPE

ELEVATION (FT)	H (FT)	Q (CFS)
20.0	3.0	59.0
21.0	4.0	68.1
22.0	5.0	76.1
23.0	6.0	83.4
24.0	7.0	90.1
25.0	8.0	96.3
26.0	9.0	102.1
27.0	10.0	107.6
28.0	11.0	112.9
29.0	12.0	117.9
30.0	13.0	122.7

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Subject BRONX RIVER DAM
OUTLET PIPE RATING

S.O. No. _____

Sheet No. 12 of 25

Drawing No. _____

Computed by GWT Checked by LAD Date 4/30/81

PIPE FLOW

$$Q = \frac{A (2gH)^{1/2}}{[1 + K_e + K_b + K_c(L)]^{1/2}}$$

$$= \frac{7.07 (644 H)^{1/2}}{[1 + .78 + 0 + .00839(30)]^{1/2}}$$

$$= 39.80 H^{1/2}$$

ELEVATION (FT)	H (FT)	Q (CFS)
20.0	1.5	48.8 ✓
21.0	2.5	62.9 ✓
22.0	3.5	74.5 ✓
23.0	4.5	84.4 ✓
24.0	5.5	93.4 ✓
25.0	6.5	101.5 ✓
26.0	7.5	109.0 ✓
27.0	8.5	116.1 ✓
28.0	9.5	122.7 ✓
29.0	10.5	129.0 ✓
30.0	11.5	135.0 ✓

$A = \pi R^2 = 7.07$ ✓
 $g = 32.2 \text{ FT/SEC}^2$ ✓
 H VARIES AND IS MEASURED
 FROM THE TOP OF PIPE
 ELEV. AT THE OUTLET. ✓
 $L = 30 \text{ FT.}$ ✓
 $K_e (K_o) = .78$ Pg. 5.5-6 ✓
 SCS NEH-5
 $K_b (K_f) = 0$ Pg 5.5-10 ✓
 SCS NEH-5
 $K_c (K_p) = .00839$ Pg 5.5-4 ✓
 SCS NEH-5
 $n = 0.014$ ✓
 TOP OF 36" DIA. PIPE AT
 OUTLET = ELEV. 18.5 FT.

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Beaver, Pa. 15009

Subject BRONX RIVER DAM S.O. No. _____
OUTLET PIPE RATING SUMMARY Sheet No. 13 of 25
Drawing No. _____
Computed by GLT Checked by LAD Date 4/30/81

OUTLET PIPE SUMMARY RATING

ELEVATION (FT)	Q (CFS)
15.5	0
17.0	21.8
17.75	47.7
20.0	48.8
21.0	62.9
22.0	74.5
23.0	83.4
24.0	90.1
25.0	96.3
26.0	102.1
27.0	107.6
28.0	112.9
29.0	117.9
30.0	122.7

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Subject BRONX RIVER

S.O. No. _____

PMP DISCHARGE

Sheet No. 14 of 25

Drawing No. _____

Box 250
Hightstown, N.J. 08520

Computed by GWT Checked by WDL

Date 4/28/81

WEIGHTED C_p VALUE FOR DRAINAGE AREA
WEIGHTED RAINFALL VALUE FOR SPS

SUBAREA	AREA	C_p	T_p	RAINFALL
1	4.97	.39	5.1	12.73
2	6.45	.50	3.6	13.20
3	4.76	.63	2.4	14.28
4	2.79	.63	2.1	14.83
5	1.10	.50	4.0	14.83
6	1.89	.56	2.8	14.83
7	4.56	.66	10.0	14.83
8	3.04	.63	2.4	14.83
9	3.30	.63	2.2	14.67
10	3.50	.63	2.0	13.20

$D.A = 36.36$ SQ. MI.

$$\frac{20.73}{36.36} = .57 \text{ } C_p \text{ WEIGHTED}$$

$$\frac{509.42}{36.36} = 14.01 \text{ IN. RAINFALL WEIGHTED}$$

SPS ϕ AT NODE 108 = 12,845 CFS
(FROM "LOWER HUDSON RIVER BASIN HYDROLOGIC FLOOD
ROUTING MODEL" PAGES 152 - 157.)

HYDROGRAPH DEVELOPED AT NODE 108 USING $t_p = 10.0$ HR
AND $C_p = 0.57$ WITH A RAINFALL OF 14.01 IN. PRODUCED
A FLOW OF 13,060 C.F.S. THE PMP RAINFALL AMOUNT
WAS THEN SUBSTITUTED TO GET THE PMP FLOWS.

RAINFALL DATA

FROM HMR - 33

DAM AND DRAINAGE AREA ARE IN ZONE 1

PMP (24 HR) 200 MI.² = 21.0 IN.

DRAINAGE AREA = 36.36 SQ. MI.

PMP (6 HR) = 96 % PMP (24 HR) 200 MI.²

PMP (12 HR) = 110 % " " "

PMP (24 HR) = 120 % " " "

PMP (48 HR) = 128 % " " "

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Box 280
Beaver, Pa. 15009

Subject BRONX RIVER DAM

S.O. No. _____

SPILLWAY CAPACITY ANALYSIS

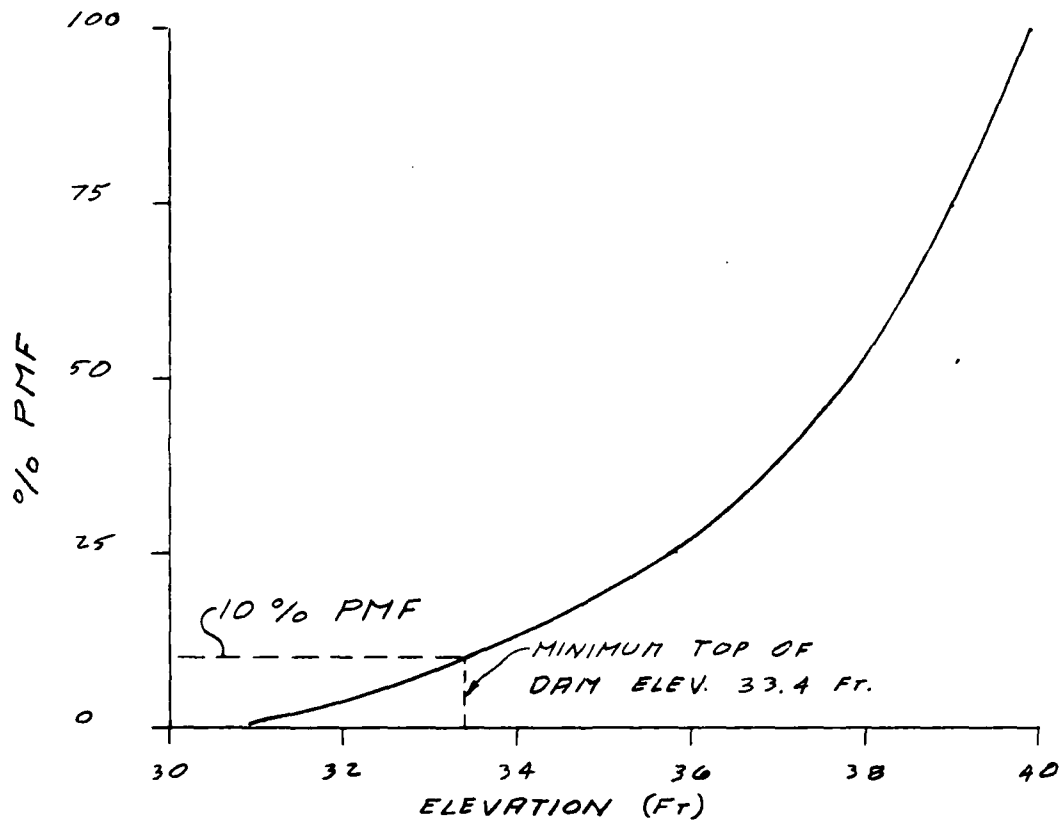
Sheet No. 15 of 25

Drawing No. _____

Computed by GWJ

Checked by LAD

Date 4/30/81



 FLOOD HYDROGRAPH PACKAGE (FHC-1)
 EAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79
 MRJ JPDAL 04 JUN 79

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
AL	NATIONAL PROGRAM FOR INSPECTION OF RUN-FLUKEAL DAMS																											
A2	HYDROLOGIC AND HYDRAULIC ANALYSIS OF RUN-FLUKEAL DAMS																											
A3	UNIT HYDROGRAPH BY SUTHERS METHOD																											
B	300	2	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B1	5																											
B2	1																											
B3	1	0.75	0.50	0.25	0.01																							
B4	1	0	1																									
B5	1																											
B6	1																											
B7	1																											
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B28	1																											
B29	1																											

 FLOOD HYDROGRAPH PACKAGE (FHC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 24 FEB 79
 HBJ JPC/ATE 04 JUN 79

RUN DATE 05/22/81
 TIME 14.12

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
 HYDROLOGIC AND HYDRAULIC ANALYSIS OF BRUNA RIVER DAM
 UNIT HYDROGRAPH BY SNYDEK METHOD

JOB SPECIFICATION									
N	NHR	NMIN	DUAY	IFR	IMIN	METRC	IPLT	IPAT	ASTAN
300	2	0	0	0	0	0	0	0	0
			JEPER	ANI	LRUPT	TRACL			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIU= 5 LRTIU= 1
 RTIUS= 1.00 C.75 C.25 C.25 0.01

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO DAM

ISTAQ	ICLMP	IECCA	ITAPE	JPLI	JPAT	INATE	ISIAE	IACTU
1	0	0	0	0	0	-1	0	0

HYDROGRAPH DATA									
IPYU	IUNG	TAKEA	SNAP	TRSDA	TRSPC	NRTIU	ISICM	ISAPE	LOCAL
1	1	30.36	0.0	30.36	0.0	0.0	0	0	0

PHCLIP DATA
 SPIE P45 K6 K12 K24 K48 K72 K96
 0.0 21.00 56.00 110.00 120.00 120.00 0.0 0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.041

LOSS DATA									
LRUPT	STARR	CLINK	RTEC	ERAIN	STARR	KTIUK	STREL	CUSTC	ALOMA
0	0.0	0.0	1.00	0.0	0.0	1.00	2.00	0.00	0.0

UNIT HYDROGRAPH DATA
 TP= 10.00 CP=0.27 NIA= 0

RELATION DATA
 SIML= -1.20 KRCM= -0.00 RTIUK= 2.00

UNIT HYDROGRAPH ST END-OF-PERIOD ORIGINATES, LAU= 9.94 HOURS, CP= 0.58 VOL= 1.00
 109. 376. 780. 1137. 1221. 1378. 1478. 1578. 1678. 1778. 1878. 1978. 2078. 2178. 2278. 2378. 2478. 2578. 2678. 2778. 2878. 2978. 3078. 3178. 3278. 3378. 3478. 3578. 3678. 3778. 3878. 3978. 4078. 4178. 4278. 4378. 4478. 4578. 4678. 4778. 4878. 4978. 5078. 5178. 5278. 5378. 5478. 5578. 5678. 5778. 5878. 5978. 6078. 6178. 6278. 6378. 6478. 6578. 6678. 6778. 6878. 6978. 7078. 7178. 7278. 7378. 7478. 7578. 7678. 7778. 7878. 7978. 8078. 8178. 8278. 8378. 8478. 8578. 8678. 8778. 8878. 8978. 9078. 9178. 9278. 9378. 9478. 9578. 9678. 9778. 9878. 9978. 10078. 10178. 10278. 10378. 10478. 10578. 10678. 10778. 10878. 10978. 11078. 11178. 11278. 11378. 11478. 11578. 11678. 11778. 11878. 11978. 12078. 12178. 12278. 12378. 12478. 12578. 12678. 12778. 12878. 12978. 13078. 13178. 13278. 13378. 13478. 13578. 13678. 13778. 13878. 13978. 14078. 14178. 14278. 14378. 14478. 14578. 14678. 14778. 14878. 14978. 15078. 15178. 15278. 15378. 15478. 15578. 15678. 15778. 15878. 15978. 16078. 16178. 16278. 16378. 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PEAK FLOW AND STORAGE TEND OF PERKINS COMPANY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CFS) AND FEET PER SECOND (FPS) PER SECOND
 AREA IN SQUARE FEET (SQ. FT.)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS				
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
				1.00	0.75	0.50	0.25	0.01
HYDROGRAPH AT	1	32.36	1	26952	15309	10240	5120	202
	(	98.17)	(	580281	435213	290141	145071	5801
LIMITED IT	2	36.36	1	20405	15328	10207	5103	202
	(	98.17)	(	577801	436041	289031	144541	5801

SUMMARY OF DAM DAILY ANALYSIS

PLAN 1	ELEVATION STORAGE LUFLOW	INITIAL VALUE 30.00 58. C.	SPELLWAY CREST 30.00 58. U.	TOP OF DAM 43.40 108. 12/1.	TIME OF MAX LUFLOW HOURS	TIME OF FAILURE HOURS
RATIO OF PWF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM STORAGE AC-FT	MAXIMUM LUFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX LUFLOW HOURS	TIME OF FAILURE HOURS
1.00	39.72	247.	20433.	30.00	30.00	0.0
0.75	38.82	223.	15226.	30.00	30.00	0.0
0.50	37.61	193.	10207.	30.00	30.00	0.0
0.25	35.66	150.	5114.	22.00	18.00	0.0
0.01	30.87	64.	403.	0.0	30.00	0.0

SHEET 20 OF 25

 FLOOD HYDROGRAPH PAKRALL (PHL-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79
 MUJ OPCSIC 04 JUN 79

A1 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
 A2 HYDROLOGIC AND HYDRAULIC ANALYSIS OF BRUNX RIVER DAM
 A3 DEWATERING ANALYSIS OF BRUNX RIVER DAM

1	100	0	5	0	3	0	0	0	0	0
2	5	5	1	1						
3	1	1	1							
4	1	1								
5	1									
6	1									
7	1									
8	1									
9	1									
10	-1									
11										
12										
13										
14										
15										
16										
17										
18										
19										
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24										
25										
26										
27										
28										
29										
30										
31										
32										
33										

1 DEWATERING BRUNX RIVER DAM

Y1	1	17.15	20	21	22	23	24	25	26
Y4	15.5	27	28	30	74.5	83.4	90.1	96.3	102.1
Y5	0	21.8	47.7	62.9	74.5	83.4	90.1	96.3	102.1
Y5	107.6	112.9	117.9	122.7	127.3	131.9	136.5	141.1	145.7
Y6	0	0.1	6.24	12.43	17.85	23.28	28.71	34.14	39.57
Y6	1.6	20	25	30	35	40	45	50	55
Y8	30.0	2.8	1.5						
Y8	33.4								
Y9	39								
K									

RUN DATE 22/2/77
TIME 14.03

NATIONAL PROGRAM FOR INSPECTION OF NON-FEELER DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF UKHNA RIVER DAM
DEWATERING ANALYSIS OF UKHNA RIVER DAM

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED

	NH ₄	NH ₄ -N	NO ₃ -N	TP	TPR	TPM	MEIC	IPLI	IPRI	INSTAN
LCU	0	5	C	C	C	C	C	C	C	C
			JUPYK	AH	LUPYK	IRALC				
			5	C	C	C	C	C	C	C

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLAN= 1 NRJLU= 1 LKJLU= 1

К. И. И. 5 = 1.00

SUB-AREA KLUDE COMPUTATION

NULL KUNFT HYDROGRAPH: 10 LAM

ISTAQ	ICOMP	IELCN	ITAPE	JPLI	JPKI	IRAME	ISPAGE	IAUDS
1	C	0	0	0	0	-1	0	0

HYDROGRAPH DATA									
TIME	INCH	TAREA	SNAP	TKSUA	TKSPC	RATIO	ADJW	ISAE	LLAL
11:00	0	46.34	6.0	46.34	1.0	0.0	0	0	0
11:15	-1					0.0	0	0	0

APPENDIX

INPUT HYDROGRAPH

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
------	--------	---------	---------	--------------

	FLK	8 HOUR	24 HOUR	72 HOUR	100% VOLUME
CLS	C*	U*	U*	U*	U*
CMS	C*	U*	U*	U*	U*
INCHES		U*U	U*U	U*U	U*U
MM		U*U	U*U	U*U	U*U
AC-ft		U*	U*	U*	U*
IN-05 CU ft		U*	U*	U*	U*

SHEET 22 OF 25

1.01	0.15	0.17	0.	10.7	20.	27.9
1.01	0.15	0.25	0.	10.7	20.	27.9
1.01	0.25	0.33	0.	10.7	20.	27.9
1.01	0.33	0.42	0.	10.7	20.	27.9
1.01	0.42	0.50	0.	10.7	20.	27.9
1.01	0.50	0.58	0.	10.7	20.	27.9
1.01	0.58	0.67	0.	10.7	20.	27.9
1.01	0.67	0.75	0.	10.7	20.	27.9
1.01	0.75	0.83	0.	10.7	20.	27.9
1.01	0.83	0.92	0.	10.7	20.	27.9
1.01	0.92	1.00	0.	10.7	20.	27.9
1.01	1.00	1.08	0.	10.7	20.	27.9
1.01	1.08	1.16	0.	10.7	20.	27.9
1.01	1.16	1.25	0.	10.7	20.	27.9
1.01	1.25	1.33	0.	10.7	20.	27.9
1.01	1.33	1.42	0.	10.7	20.	27.9
1.01	1.42	1.50	0.	10.7	20.	27.9
1.01	1.50	1.58	0.	10.7	20.	27.9
1.01	1.58	1.67	0.	10.7	20.	27.9
1.01	1.67	1.75	0.	10.7	20.	27.9
1.01	1.75	1.83	0.	10.7	20.	27.9
1.01	1.83	1.92	0.	10.7	20.	27.9
1.01	1.92	2.00	0.	10.7	20.	27.9
1.01	2.00	2.08	0.	10.7	20.	27.9
1.01	2.08	2.17	0.	10.7	20.	27.9
1.01	2.17	2.25	0.	10.7	20.	27.9
1.01	2.25	2.33	0.	10.7	20.	27.9
1.01	2.33	2.42	0.	10.7	20.	27.9
1.01	2.42	2.50	0.	10.7	20.	27.9
1.01	2.50	2.58	0.	10.7	20.	27.9
1.01	2.58	2.67	0.	10.7	20.	27.9
1.01	2.67	2.75	0.	10.7	20.	27.9
1.01	2.75	2.83	0.	10.7	20.	27.9
1.01	2.83	2.92	0.	10.7	20.	27.9
1.01	2.92	3.00	0.	10.7	20.	27.9
1.01	3.00	3.08	0.	10.7	20.	27.9
1.01	3.08	3.17	0.	10.7	20.	27.9
1.01	3.17	3.25	0.	10.7	20.	27.9
1.01	3.25	3.33	0.	10.7	20.	27.9
1.01	3.33	3.42	0.	10.7	20.	27.9
1.01	3.42	3.50	0.	10.7	20.	27.9
1.01	3.50	3.58	0.	10.7	20.	27.9
1.01	3.58	3.67	0.	10.7	20.	27.9
1.01	3.67	3.75	0.	10.7	20.	27.9
1.01	3.75	3.83	0.	10.7	20.	27.9
1.01	3.83	3.92	0.	10.7	20.	27.9
1.01	3.92	4.00	0.	10.7	20.	27.9
1.01	4.00	4.08	0.	10.7	20.	27.9
1.01	4.08	4.17	0.	10.7	20.	27.9
1.01	4.17	4.25	0.	10.7	20.	27.9
1.01	4.25	4.33	0.	10.7	20.	27.9
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1.01	4.50	4.58	0.	10.7	20.	27.9
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1.01	4.67	4.75	0.	10.7	20.	27.9
1.01	4.75	4.83	0.	10.7	20.	27.9
1.01	4.83	4.92	0.	10.7	20.	27.9
1.01	4.92	5.00	0.	10.7	20.	27.9
1.01	5.00	5.08	0.	10.7	20.	27.9
1.01	5.08	5.17	0.	10.7	20.	27.9
1.01	5.17	5.25	0.	10.7	20.	27.9
1.01	5.25	5.33	0.	10.7	20.	27.9
1.01	5.33	5.42	0.	10.7	20.	27.9
1.01	5.42	5.50	0.	10.7	20.	27.9
1.01	5.50	5.58	0.	10.7	20.	27.9

SHEET 25 OF 25

1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	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PEAK CUFFLOW IS 125. AT TIME 0.0 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CF ₃					
122°	12%	63%	83%	93%	231%
CM ₂	3°			2°	23%
1°CH ₂ ES		0.03	0.03	0.03	0.03
M ₄		0.70	0.75	0.75	3.12
AC-H		53%	51%	57%	57%
THUS C ₁ M		60%	71%	71%	71%

APPENDIX D

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APPENDIX E

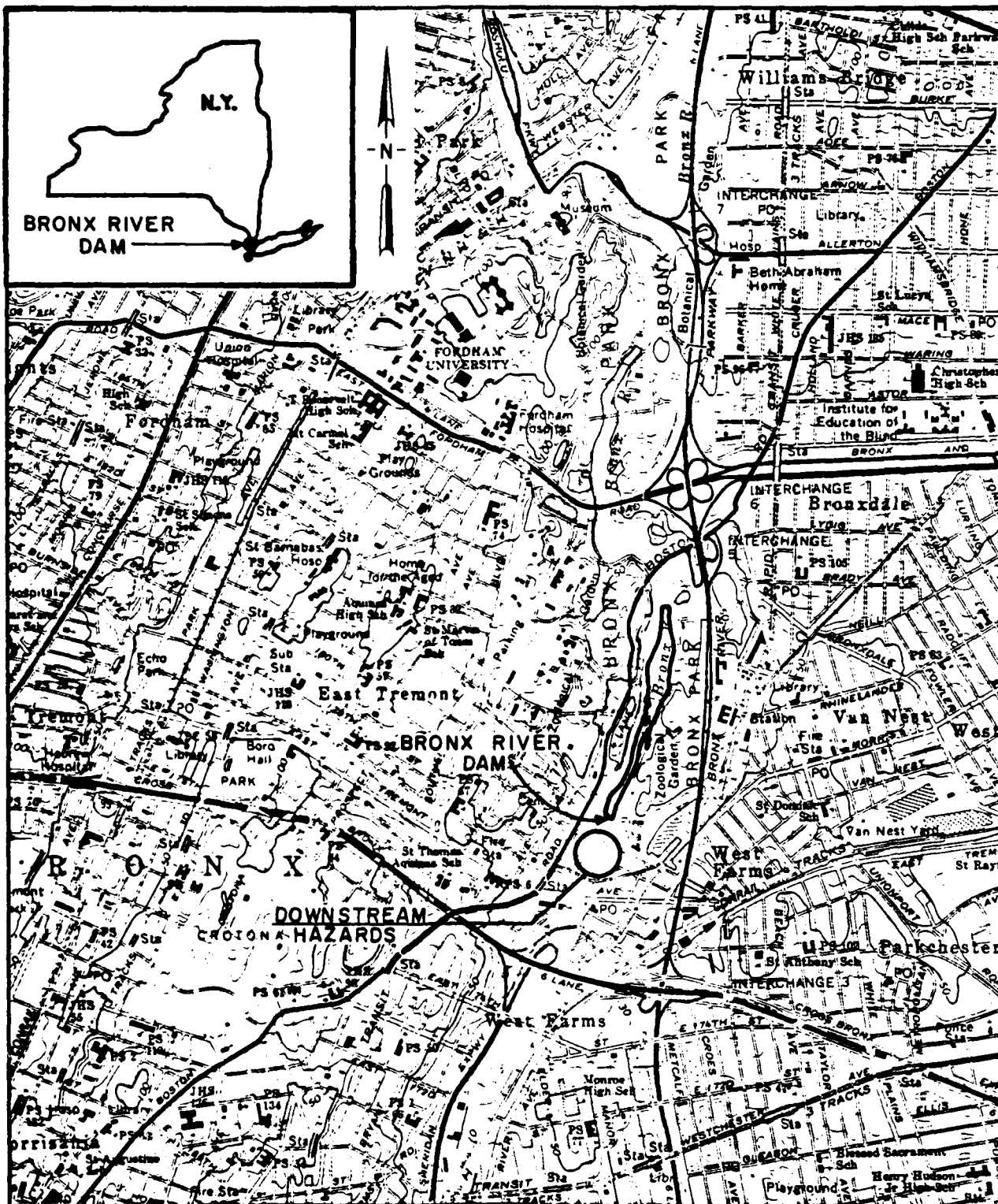
DRAWINGS

CONTENTS

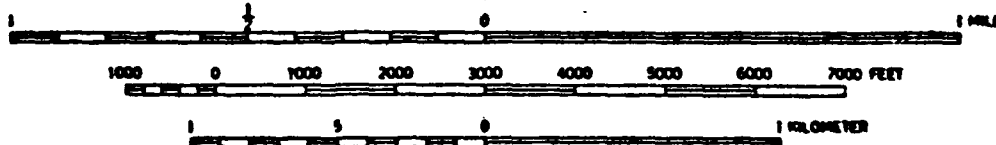
Location Plan

Watershed Map

Field Sketch



SCALE 1:24000

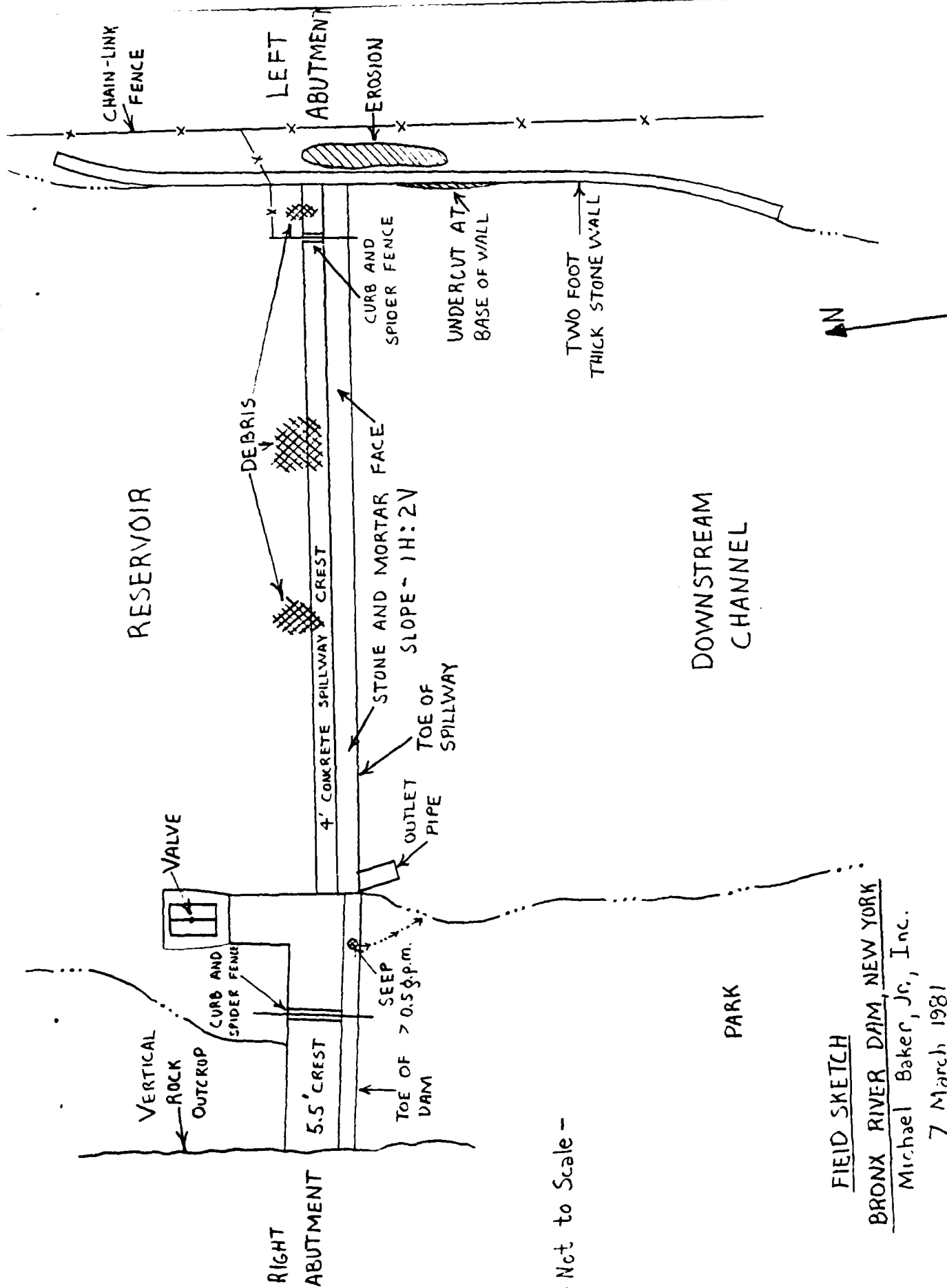


REFERENCES:

1. U.S.G.S. 7.5' CENTRAL PARK, N.Y.-N.J. QUADRANGLE. PHOTOREVISED 1979
2. U.S.G.S. 7.5' FLUSHING, N.Y. QUADRANGLE. PHOTOREVISED 1979

LOCATION PLAN
BRONX RIVER DAM





- Not to Scale -

FIELD SKETCH

BRONX RIVER DAM, NEW YORK

Michael Baker, Jr., Inc.

7 March 1981

PLATE 1

APPENDIX F
STABILITY CALCULATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject BRONX RIVER DAM
Stability Analysis
Spillway Section
Computed by DWM

S.O. No. 1-223-00-ALP

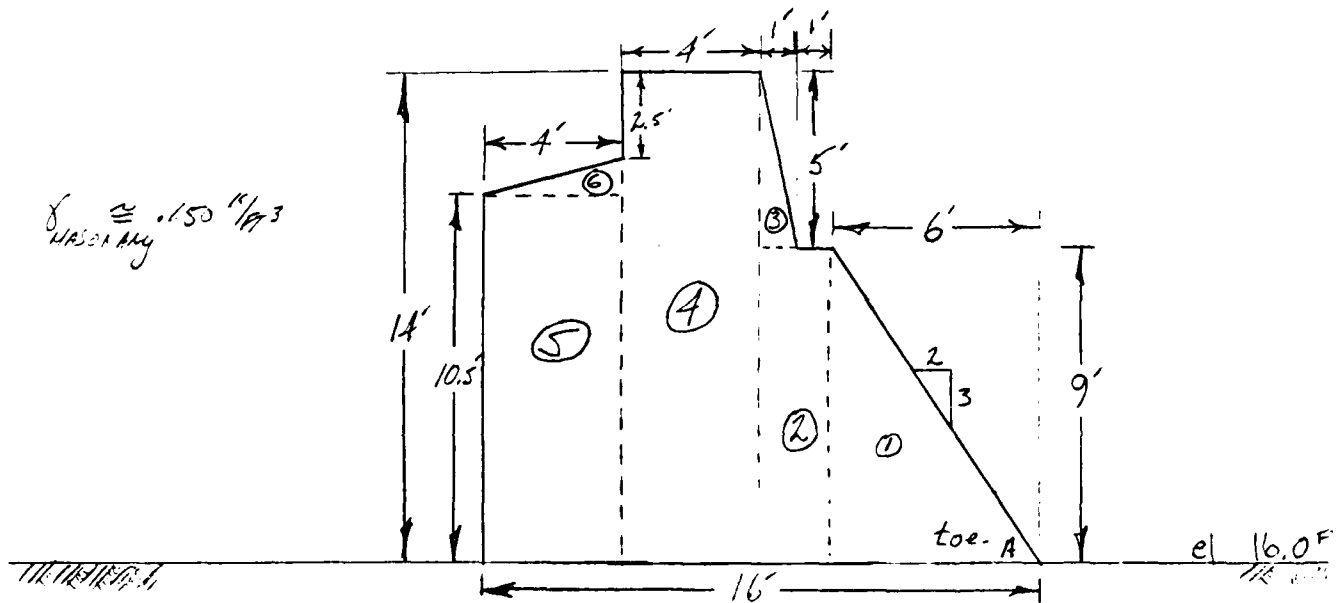
Sheet No. 1 of 11

Drawing No. _____

Date MA 9, 1931

Spillway Cross-Section
(Overflow Section)

MASONRY ROCK DAM



Section		γ	W	Distance From toe	M
①	$\frac{1}{2}(6)(9) = 27$	.15 $\frac{1}{ft^3}$	4.05 $\frac{1}{ft^3}$	4.0	16.2 $K-Ft$
②	$2(9) = 18$	.15	2.7	7.0	18.9
③	$\frac{1}{2}(1)(5) = 2.5$	.15	0.375	7.667	2.875
④	$4(14) = 56$	.15	8.4	10.0	84
⑤	$4(10.5) = 42$	.15	6.3	14.0	88.2
⑥	$\frac{1}{2}(1)(4) = 2$	.15	<u>0.3</u>	13.333	<u>4.0</u>
			22.125		214.175

Resultant = 22.125 kips

Distance From toe = $\frac{214.175}{22.125} = 9.68 \text{ Ft From toe}$

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Box 280
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Subject BRONX RIVER DAM
Stability Analysis

Computed by DUM Checked by JGU

S.O. No. 1333-2-AAA

Sheet No. 2 of 11

Drawing No. _____

Date May 3, 1981

Situations to be considered

Case I Normal Operating Conditions, full uplift

Case II Same as Case I plus Ice loading

Case III Conditions due to PMF, full uplift

Case IV Conditions due to Full PMF, full uplift

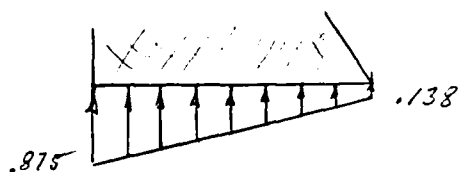
Case I Pool level = el 30.0' $H_w = 14$ FT

Tail water level = el. 13.5' $H_w = 2.2$ FT

Uplift

Reservoir Side = $14(.0625) = 0.875$ KSF

Tail water Side = $(2.2)(.0625) = 0.138$ KSF



$$\text{Resultant} = \left(\frac{.875 + .138}{2} \right) (16) = 8.104 \text{ Kips}$$

$$\begin{aligned} \text{Location} &= \frac{\left[(.138)(16) \right] \frac{16}{2} + \left[(.875 - .138) \left(\frac{1}{2} \right) (16) \right] \frac{16}{3}}{8.104} \\ &= 6.060 \text{ FT} \end{aligned}$$

$$\Rightarrow 16 - 6.06 = 9.94 \text{ FT from toe}$$

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Subject BRONX RIVER LEVEE
Stability Analysis

Computed by JMM

Checked by JGU

S.O. No. 12338-5-AK

Sheet No. 3 of 11

Drawing No. _____

Date 11-8-1981

Hydro Static Pressure

$$\text{Reservoir Side} = (14)^2 (.0625) \frac{1}{2} = 6.125 \text{ Kips}$$

$$\text{location} = \frac{14}{3} = 4.667 \text{ Ft from base level (of 16.0)}$$

$$\text{Tailwater Side} = (2.2)^2 (.0625) \frac{1}{2} = .151 \text{ Kips}$$

$$\text{location} = \frac{2.2}{3} = 0.733 \text{ Ft from base level}$$

Addition Vertical load Due to Tailwater

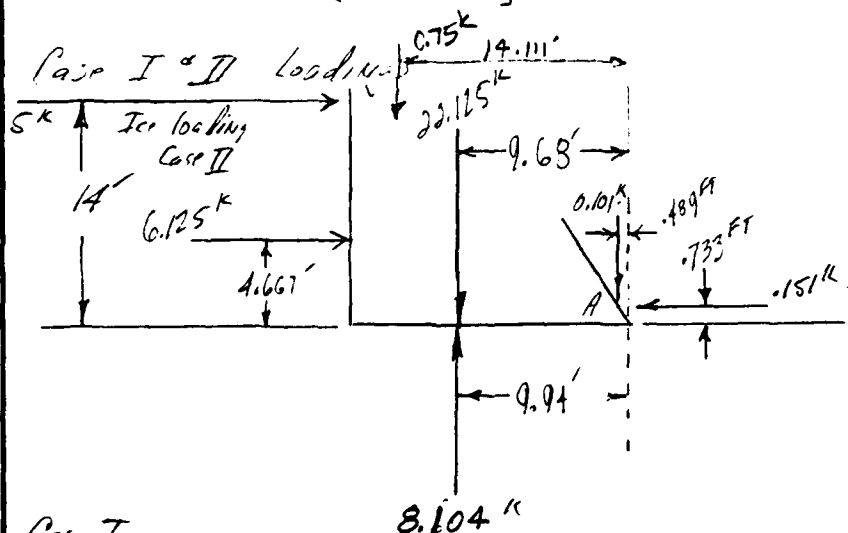
$$W = 2.2 \left[\left(\frac{2}{3} \right) (2.2) \right] \left(\frac{1}{2} \right) (.0625) = 0.101 \text{ Kips}$$

$$\text{location} \left[\left(\frac{2}{3} \right) (2.2) \right] \frac{1}{3} = 0.489 \text{ Ft from base}$$

UPSTREAM

$$\begin{aligned} 4(2.5)(.0625) &= .625 \text{ K} & 14' \\ 1 \left(\frac{1}{2} \right) (.0625) &= .125 \text{ K} & 14.66' \\ & \underline{0.75 \text{ K}} \end{aligned}$$

$$\begin{aligned} \text{Location} &= \frac{(.625)(14) + (.125)(14.66)}{.75} \\ &= 14.111 \text{ ft from toe} \end{aligned}$$



Case I

Overturning

$$\begin{aligned} F.S._{\text{overturning}} &= \frac{(.75)(14.111) + 22.125(9.68) + 0.101(.489) + .733(.151)}{8.104(3.74) + 4.667(6.125)} \end{aligned}$$

$$F.S. = 2.96$$

overturning

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Box 280
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Subject Brown River Dam S.O. No. 13889-25-4A
Stability Analysis Sheet No. 4 of 11
Drawing No. _____
Computed by DWM Checked by JGU Date Mar 3, 1981

Sliding

$$R = \sum V \tan \phi + SA$$
$$= (22.125 + 0.101 + 0.75 - 8.104) 0.7 + 2(16)$$
$$= 42.41 \text{ kps}$$

$$S = 2 \text{ KSF}$$
$$\phi = 35^\circ$$

$$H = 6.125 - .151$$
$$= 5.974 "$$

$$F.S. = \frac{42.41}{5.974}$$

Sliding

$$F.S. = 7.10$$

Sliding

Case II

Overturning

$$F.S. = \frac{7.68(22.125) + .101(.481) + .753(.151) + .75(14.111)}{8.104(7.94) + 4.667(6.125) + 5(14)}$$

Overturning

$$F.S. = 1.26$$

Overturning

Sliding

$$R = 42.41$$

$$H = 6.125 + 5 - .151$$
$$= 10.974$$

$$F.S. = \frac{42.41}{10.974}$$

Sliding

$$F.S. = 3.36$$

Sliding

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Box 280
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Subject Rock River Dam
Stability Analysis

S.O. No. 1322-11-ALL

Sheet No. 5 of 11

Drawing No. _____

Computed by LWM

Checked by JGU

Date 14.3.1931

Case III

Reservoir level = el 57.8

$H_w = 21.8 \text{ FT}$

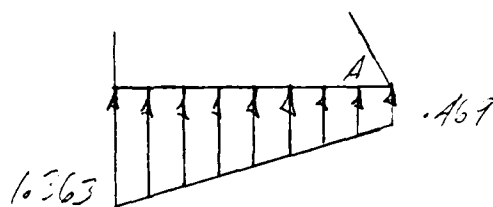
Tailwater level = el 23.5

$H_w = 7.5 \text{ FT}$

4. lift

$21.8(.0625) = 1.363 \text{ KSF}$ Reservoir Side

$7.5(.0625) = .469 \text{ KSF}$ Tailwater Side



$$\text{Resultant} = \left(\frac{.469 + 1.363}{2} \right) (16) = 14.656 \text{ kips}$$

$$\begin{aligned} \text{location} &= \frac{[.469(16)] \frac{16}{2} + \left[(1.363 - .469) \left(\frac{1}{2} \right) (16) \right] \frac{2}{3} (16)}{14.656} \\ &= 9.301 \text{ FT from toe} \end{aligned}$$

Static Pressure

Bottom Dam = $21.8(.0625) = 1.363$

Top Dam = $7.8(.0625) = .488$

Resultant = $\frac{(1.363 + .488)}{2} (14) = 12.957 \text{ kips}$

$$\text{location} = \frac{[.488(14.0)] \frac{14}{2} + \left[(1.363 - .488) \left(\frac{1}{2} \right) (14.0) \right] \frac{2}{3} (14)}{12.957}$$

Resultant = 12.957 kips

Resultant = 12.957 kips

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Box 280
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Subject Rock River Dam S.O. No. 13222-00-17A
Stability Analysis Sheet No. 6 of 11
Drawing No. _____
Computed by UUM Checked by JGU Date May 8, 1931

Hydrostatic Pressure -

Tailwater Side

$$\text{Resultant} = \frac{1}{2}(7.5)^2(.0625)$$

$$= 1.758 \text{ kips}$$

$$\text{location} = 7.5/3 = 2.5 \text{ ft above base}$$

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Box 280
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Subject Lower River Dam
Stability Analysis

Computed by DWM

Checked by JGU

S.O. No. 12903-23-AS4

Sheet No. 7 of 11

Drawing No. _____

Date May 3, 1981

Addition Vertical loading

Reservoir Side

$$4(2.5)(.0625) = .625^k$$

location from toe

14'

$$(1)(4)(\frac{1}{2})(.0625) = \frac{.125^k}{.750^k}$$

14.667'

$$\text{Resultant} = .750^k$$

$$\text{location} = \frac{.625(14) + .125(14.667)}{.750}$$

$$= 14.111 \text{ Ft from toe}$$

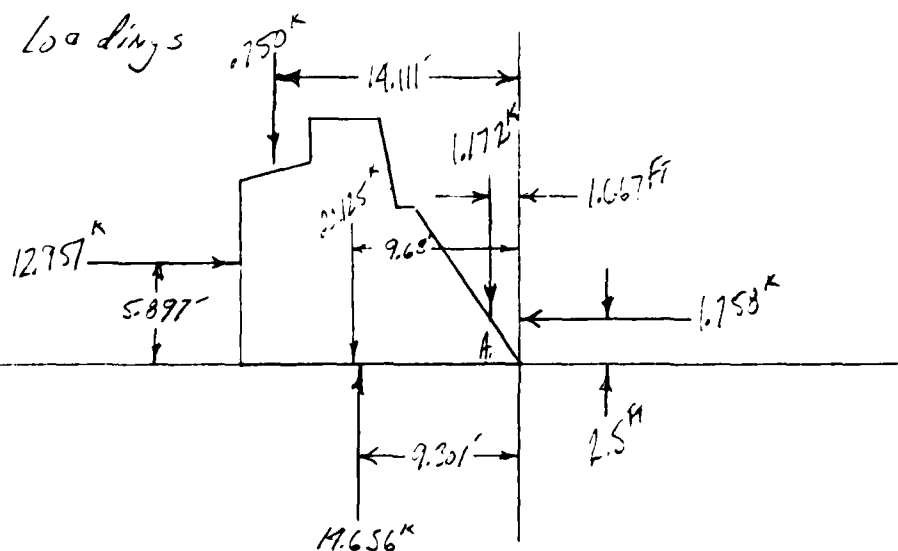
Tailwater Side

$$2.5 \left[\left(\frac{2}{3} \right) (7.5) \right] \frac{1}{2} (.0625) = 1.172 \text{ Kips}$$

location

$$\left[\left(\frac{2}{3} \right) (7.5) \right] \frac{1}{3} = 1.667 \text{ Ft from toe}$$

Case III Loadings



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Subject From Dam Dam
Stability Analysis

Computed by JWM Checked by JGU

S.O. No. 13907-30-ALP

Sheet No. 8 of 11

Drawing No. _____

Date May 8, 1931

Overturning

$F.S. =$
Overturning

$$\frac{22.125(9.68) + 1.172(1.667) + .750(14.111) + 1.755(2.5)}{12.957(5.897) + 14.656(7.301)}$$

$F.S. = 1.086$
Overturning

Sliding

$$R = (22.125 + .750 + 1.172 - 14.656) \cdot 7 + 2(16)$$

$$= 38.574^k$$

$$H = 12.957 - 1.758 = 11.199$$

$$F.S. = \frac{R}{H} = \frac{38.574}{11.199}$$

$F.S. = 3.444$
Sliding

Case IV

Pool level = el 37.7 FT

$H_w = 23.9$ FT

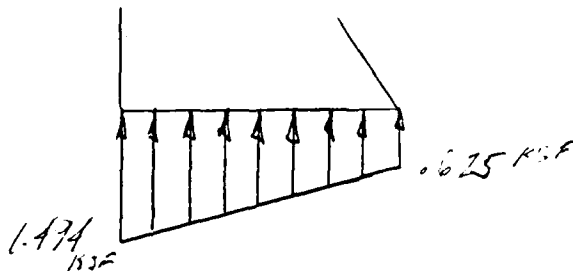
Tailwater level = 26.0 FT

$H_w = 10.0$ FT

Uplift

$23.9(.0625) = 1.474$ KSF Reservoir Side

$10(.0625) = .625$ KSF Tailwater Side



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Box 280
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Subject Elbow River Dam
Stability Analysis

Computed by DWH

Checked by JGU

S.O. No. 13222-33-ARA

Sheet No. 9 of 11

Drawing No. _____

Date May 9, 1991

$$\text{Resultant} = \left(\frac{1.494 + .625}{2} \right) (16) = 16.952 \text{ kips}$$

$$\text{location} = \frac{[.625(16)] \frac{16}{2} + [(1.494 - .625)(\frac{1}{2})(16)] \frac{2}{3}(16)}{16.952}$$
$$= 9.094 \text{ from toe of Dam}$$

Hydrostatic Pressure

Reservoir Side Bottom of Dam = $23.9(.0625) = 1.494$

Top of Dam = $(23.9 - 14)(.0625) = .619$

$$\text{Resultant} = \left(\frac{1.494 + .619}{2} \right) 14 = 14.789 \text{ k}$$

$$\text{Location} = \frac{[.619(14)] \frac{14}{2} + [(1.494 - .619) \frac{1}{2}(14)] \frac{14}{3}}{14.789}$$
$$= 6.035 \text{ FT above base of Dam}$$

Tailwater Side

$$\text{Resultant} = \frac{1}{2}(10)^2(.0625) = 3.125 \text{ k}$$

$$\text{location} = \frac{10}{3} = 3.333 \text{ FT above base of Dam}$$

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Subject BRONX River Dam
Stability Analysis

S.O. No. 12089-22-ALL

Sheet No. 10 of 11

Drawing No. _____

Computed by DOUM Checked by JGU

Date May 8, 1981

Additional Vortex loading

$$\begin{aligned} \text{Reservoir Size} \quad 4(2.5)(.0625) &= .625^k \\ (1)(4)(.0625) &= .125^k \\ \hline &= .750^k \end{aligned}$$

location from toe
14'
14.667'

Resultant = .750^k

$$\begin{aligned} \text{location} &= \frac{.625(14) + .125(14.667)}{.750} \\ &= 14.111 \text{ FT from toe} \end{aligned}$$

Tailwater Seep

$$\begin{aligned} \frac{1}{2}(6)(9)(.0625) &= 1.688^k \\ 7(1)(.0625) &= 0.438 \\ \frac{1}{2}(2)(1)(.0625) &= 0.006 \\ \hline &= 2.132^k \end{aligned}$$

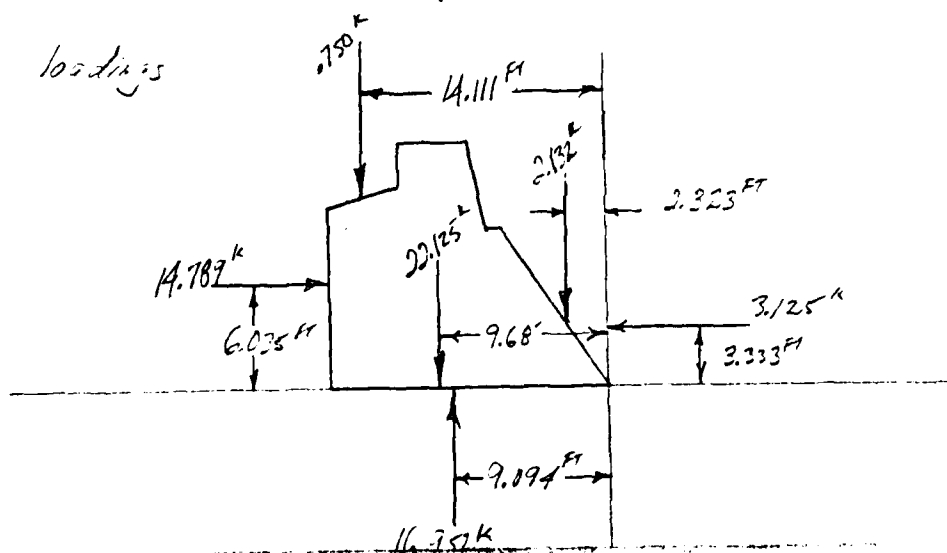
location from toe

2'
3.5
7.333

Resultant = 2.132^k

$$\begin{aligned} \text{location} &= \frac{(1.688)(2) + (.438)(3.5) + .006(7.333)}{2.132} \\ &= 2.323 \text{ FT from toe} \end{aligned}$$

Page IV loadings



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Subject TRUCK RUN LANE S.O. No. 15-229-21-A/A
SHEDS FOR LANE Sheet No. 11 of 11
Drawing No. _____
Computed by LUM Checked by JGU Date 11/1/79

Overturning

$F.S. =$
Overturning

$$\frac{2.125(9.69) + 2.132(2.323) + 3.125(3.232) + .750(14.11)}{14.789(6.925) + 16.752(9.924)}$$

$F.S. = 0.986$ <u>Overturning</u>

Sliding

$$R = (.750 + 2.125 + 2.132 - 16.752) \cdot 7 + 2(14)$$

$$= 37.639 \text{ k}$$

$$H = 14.789 - 2.125 = 11.664 \text{ k}$$

$$F.S. = \frac{R}{H} = \frac{37.639}{11.664}$$

$F.S. = 3.227$ <u>Sliding</u>

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Box 280
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Subject Elroy River Dam
Stability Analysis

S.O. No. 3828-00-ADA-17-5

Sheet No. _____ of _____

Drawing No. _____

Computed by DJM Checked by JGU

Date May 27, 1961

Resultant Location $\Rightarrow \frac{EH}{EV}$

Case I

$$\begin{aligned} \text{Location} &= \frac{22.125(9.68) + 0.101(.489) + 733(.151) - 6.06(9.94) - 4.667(6.125)}{0.75 + 22.125 - 8.104 + .101} \\ &= \underline{7.78 \text{ FT}} \end{aligned}$$

Case II

$$\begin{aligned} \text{Location} &= \frac{22.125(9.68) + 0.101(.489) + 733(.151) - 6.06(9.94) - 4.667(6.125) - 5(14) + 75(14.111)}{22.125 - 8.104 + .101 + 0.75} \\ &= \underline{3.08 \text{ FT}} \end{aligned}$$

Case III

$$\begin{aligned} \text{Location} &= \frac{22.125(9.68) + 1.172(1.667) + 1.753(2.5) - 12.957(5.397) - 14.656(9.701) + 75(14.111)}{22.125 + 1.172 - 14.656 + 75} \\ &= \underline{1.957 \text{ FT}} \end{aligned}$$

Case IV

$$\begin{aligned} \text{Location} &= \frac{22.125(9.68) + 2.132(2.323) + 3.125(3.333) + 75(14.111) - 14.789(6.335) - 16.752(7.094)}{22.125 + 2.132 + 75 - 16.752} \\ &= \underline{- .409 \text{ FT}} \end{aligned}$$

APPENDIX G
BACKGROUND DOCUMENTS

No Background Documents
Were Available For This Dam

END

DATE
FILMED

11-81

DTIC